Vietnam Development Report 2019

Connecting Vietnam for Growth and Shared Prosperity

Final Report
December 2019

WORLD BANK GROUP

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Foreword

With rising incomes, declining poverty levels and greater participation in global value chains, Vietnam has greatly benefited from having an open economy, conducive investment climate, and relatively good connectivity to the region and the rest of the world. Given emerging challenges and threats to its growth trajectory—through increasing international protectionism, a slowing global economy, and climate change—ensuring Vietnam's competitiveness will require implementation of policies and investments that position the country to best adapt to the changing global environment.

A flagship report prepared by the World Bank Vietnam country and global teams, *Vietnam Development Report (VDR) 2019: Connecting Vietnam for Growth and Shared Prosperity* presents a set of new and original analyses as well as building on new research building on the foundation set by two other reports: *Vietnam 2035: Toward Prosperity, Creativity, Equity, and Democracy* and *World Development Report 2020: Trading for Development in the Age of Global Value Chains.*

This report features a comprehensive overview of connectivity issues in Vietnam and uses a set of new analytical tools and analyses to inform policy makers and other key stakeholders on policy options and investment strategies to support Vietnam's integration with global and domestic markets, strengthen, and promote spatial inclusion, along with its resilience.

In conclusion, the report presents a set of nine focused recommendations organized in four mutually reinforcing areas of connectivity related to (a) Integration with Global Markets, (b) Integration across Domestic Markets, (c) Spatial Inclusion, and (d) Building Resilience.

I am grateful for the close collaboration between the World Bank and Ministry of Planning and Investment, through the Vietnam Institute for Development Strategy led by Mr. Nguyễn Văn Vịnh, Vice President, and also for the financial support provided by the Government of Australia through the Second Australia–World Bank Group Strategic Partnership in Vietnam.

The report is published at a critical time when the Government of Vietnam is developing its new development strategy to guide the next 10 years, through its Socio-Economic Development Strategy for 2021–2030. I believe the report findings provide valuable insights into Vietnam's connectivity challenges and a way forward in addressing them.

Victoria Kwakwa
Vice President
East Asia and Pacific
The World Bank

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The team of principal authors was led by Jung Eun Oh (Senior Transport Economist), with support from Brian Mtonya (Senior Economist), and included, in alphabetical order: Charles Kunaka (Lead Private Sector Specialist), Mathilde Lebrand (Economist), Obert Pimhidzai (Senior Economist), Phạm Minh Đức (Senior Economist), Roman Constantin Skorzus (Consultant), and Steven M. Jaffee (former Lead Agriculture Economist). The broader team providing inputs to the report included Chiyu Niu (Consultant), Claire Honore Hollweg (Senior Economist), Deborah Elisabeth Winkler (Consultant), Douglas Zhihua Zeng (Senior Economist), Hoàng Anh Dũng (Senior Transport Specialist), Nguyễn Thị Xuân Thúy (Consultant), Martin Molinuevo (Senior Private Sector Specialist), Raghav Pant (Senior Researcher, Oxford Infrastructure Analytics), Xavier Espinet Alegre (Transport Specialist), and Yin Yin Lam (Senior Transport Specialist).

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Abbreviations

AFTA	Asean Free Trade Area
ASEAN	Association of Southeast Asian Nations
B2C	Business to Customer
BCRs	Benefit-Cost Ratios
BRI	Belt and Road Initiative
CICPEC	China Indochina Peninsula Economic Corridor
CMTI	Cai Mep International Terminal
CMTV	Cai Mep Thi Vai Port
CP-TPP	Comprehensive Progressive Trans-Pacific Partnership
CVTS	Commercial Vehicle Tracking System
DRVN	Directorate for Roads of Vietnam
DWT	Deadweight Tons
EAEL	Expected Annual Economic Losses
EZ	Economic Zones
FDI	Foreign Direct Investment
FERG	Foodborne Disease Burden Epidemiology Reference Group
FOL	Foreign Ownership Limits
GHN	Giao Hang Nhanh
GMS	Greater Mekong Subregion
GNI	Gross National Income
GSO	General Statistics Office
GVC	Global Value Chains
HCMC	Ho Chi Minh City
IATA	International Air Transport Association
ICD	Inland Container Depots
ICT	Information and Communication Technologies
IFTI	Intermodal Freight Transportation Institute
IP	Industrial Parks
IT	Information Technology
IWT	Inland Waterways Transport
JV	Joint Venture
KPIs	Key Performance Indicators
LPI	Logistics Performance Index
LSP	Logistics Service Providers
MARD	Ministry of Agriculture and Rural Development

MNC	Multinational Corporation
MoH	Ministry of Health
MoIT	Ministry of Industry and Trade
MoNRE	Ministry of Natural Resources and Environment
MoT	Ministry of Transport in Vietnam
MPAC	ASEAN Master Plan for Connectivity
NH5	National Highway No. 5
NTMs	Non-Tariff Measures
OECD	Organization for Economic Development and Co-Operation
PCB	Printed Circuit Boards
PL	Party Logistics
PPP	Purchasing Power Parity
RCA	Revealed Comparative Advantage
RCP	Representative Concentration Pathways
RO–RO	Roll-On/Roll-Off
SMEs	Small and Medium-Sized Enterprises
TFI	Topica Founder Institute
TLC	Transport and Logistics Costs
UCCs	Urban Consolidation Centers
US-BTA	Bilateral Trade Agreement Between the United States and Vietnam
VDR	Vietnam Development Report
VHLSS	Vietnam Household Living Standards Survey
VLA	Vietnam Association of Logistics Services Enterprises
VLI	Vietnam Logistics Research and Development Institute
VPA	Vietnam Seaports Association
VSIC	Vietnam Standard Industrial Classification
WTO	World Trade Organization

Currency Measure

Currency unit — US$

Weight And Measures

Metric system

Baseline Data Year

Macroeconomic data — 2012, 2017

Census data — 2009, 2011, 2015, 2016

Business survey data — 2011, 2016, 2018

Exchange Rates

US$1 in 2016 = VND 22,500

US$1 in 2012 = VND 22,000

US$1 in 1999 = VND 14,000

Currency Inflation

US$1 in 2016 = US$1.5 in 1999

US$1 in 2016 = US$1.05 in 2012

Executive Summary

The Vietnam Development Report (VDR) is a series of flagship analytical and policy reports by the World Bank Vietnam Country Team. This report, *VDR 2019: Connecting Vietnam for Growth and Shared Prosperity,* presents a comprehensive overview of connectivity issues in Vietnam and original analyses to inform policy options and investment strategies to support Vietnam's integration with global and domestic markets, spatial inclusion, and resilience.

The State of Connectivity

Globally, Vietnam is among the most open economies with a trade-to-GDP ratio of 190 percent in 2018. Through the removal of both tariff and non-tariff barriers and fulfilling its commitment in several regional trade agreements, the country has made remarkable achievements in trade liberalization. Vietnam's major trade partners located in East Asia, North America, and Europe are reached mostly by sea or air. Trade with bordering neighbors is limited and thus trade across border-crossing points is minimal except for northern borders with China, which has seen growth in recent years. The country's trade flows are concentrated at twelve of its 48 border gates—two airports, five seaports and five border crossing points—which collectively handled 86 percent of total trade value in 2016.[1] As the trade grows, congestion at and near these international gateways and border-crossing points has also increased. In addition to the current major trade partners, various regional trade relations and connectivity initiatives are relevant to Vietnam, including with Southeast Asian neighbors, and South Asia—particularly India—over land, given the rapidly growing trade relationships.

In the meantime, Vietnam's transport network has undergone a significant expansion over the past decades. The most remarkable development in network expansion has occurred in the road sector. As of 2016 the total length of the road network, excluding village roads, reached over 300,000 km, including about 1,000 km of expressways—a fully access-controlled toll road system. Vietnam is endowed with an extensive network of natural waterways, including nearly 16,000 km of managed navigable routes carrying significant traffic around the Red River Delta and Mekong Delta areas. However, only about 2,600 km of the waterways can reliably handle barges greater than 300 deadweight tons, with rudimentary terminal infrastructure at most of its numerous river ports. Vietnam's century-old railway system is mostly single-tracked and non-electrified, which has remained unchanged over the past decades with very limited capital investments.

Vietnam's extensive seaport system includes 45 ports and nearly 200 terminals. Maritime cargo throughput has continued to increase, along with domestic throughput via coastal or short-sea shipping. Some of the key seaports operate at or near capacity, with limited room for capacity expansion due to their confines within built-up urban areas. Traffic congestion around these ports and along the connecting national highway systems exacerbates cargo movement, causing delays

and negatively affecting the urban mobility of these major cities. Vietnam's aviation sector has seen rapid growth in the recent years, with its air freight growing at an average rate of 10.8 percent per year from 2009 to 2017. Despite the growing importance of air freight transportation, which accounts for about 25 percent of Vietnam's export and import value, infrastructure is still limited. Only four of 22 airports in Vietnam have separate cargo terminals, and two have onsite logistics centers.

Despite this remarkable success, Vietnam still faces many connectivity challenges. The quality and extent of transport infrastructure is uneven across the country; some key trade corridors and international gateways are growing increasingly congested while others remain underutilized or underdeveloped, as seen with logistics services, especially the segment serving the domestic markets. Natural disasters and other hazards pose increasing threats to the country's infrastructure and livelihood. With these complex challenges in the backdrop, in this report we examine the link between connectivity and three critical development goals of Vietnam—integration, inclusion and resilience.

Integrating with Global Markets

Vietnam's trade grew alongside its deepening global integration and participation into global value chains. The revolution in information and communication technologies and falling transportation and communications costs drove offshoring and unbundling of production from the developed to the developing world and gave rise to global value chains. As an active participant in global value chains, Vietnam benefits from jobs and knowledge created from its involvement in multinational corporation production.

For this report, we explored how Vietnam's integration with global markets can be further supported through a connectivity strategy, and in doing so, carried out an extensive spatial analysis to address the following questions:

- Which specific sectors or value chains require the most attention?
- Are some value chains more dependent on transport and logistics connectivity than others?
- Which corridors will prove critical as Vietnam aspires to improve its trade competitiveness?

Our analysis has resulted in identification of "value chain critical" transport corridors for nine value chains, which combined account for over 70 percent of Vietnam's export.[2] Geographically, these key corridors are located (a) around the largest economic centers—Hanoi and HCMC—connecting nearby provinces that participate in the value chains, (b) between Mekong delta region and HCMC, (c) between Hanoi and northern Chinese borders, (d) along the north-south coastal line, and (e) between central highlands and the south. Ensuring quality infrastructure and necessary logistics services along these corridors would help lower the trade and transport costs associated with these value chains, which are crucial for Vietnam's export competitiveness.

Vietnam's international trade is predominantly handled at a handful of key airports, seaports, and border crossing points. With the rapid increase in air cargos, many stakeholders are increasingly concerned with the physical and operational capacities at key airports. Two historically dominant seaports in Ho Chi Minh City and Haiphong operate near capacity, with connecting roads plagued

with burgeoning congestion. At the same time, the relatively new deep-sea ports in Vung Tau seaport complex and Lach Huyen present opportunities to further consolidate cargo, attract large intercontinental vessels, and hence lower transport costs and transit time. Investments in hinterland connectivity are critical for success of these ports. These challenges around international gateways—capacity constraints, congestion, and mismatch between supply and demand—point to the need to bring a network perspective in planning and developing gateways, moving away from the current decentralized planning whereby local authorities compete to host key gateways.

Economic clusters in Vietnam, in the form of industrial parks or economic zones, have been developed around main corridors, near primary international gateways, or around major urban areas. Their success, measured in terms of investments attracted and employment generated, is affected by connectivity, along with other factors. As Vietnam develops a major high-capacity, high-speed transport network—such as the North–South Expressway—thereby shortening economic distances across the country, new transport nodes are created as potential candidates for future economic clusters. Future investments in major connective infrastructure should therefore be closely coordinated with land-use plan to encourage development of the land surrounding high-value transport nodes for high productivity activities. "Economic densities" should be created along these new corridors.

Integrating Domestic Markets

The Vietnamese population is growing richer and more urban. The "consumer class," which consumes US$5.50 or more per person per day, is rapidly expanding from about 49 percent in 2010 to over 70 percent in 2016. Approximately 89 percent of urban dwellers belong to the consumer class, compared to around 66 percent of the rural population. This emerging group consumes more, and more diverse, goods and services than their poorer counterparts. These changes in consumption patterns, caused by a sharp rise of incomes, could lead to changes in what is moved where, how, and at what costs.

Vietnam faces complex food problems related to the supply, distribution, and quality assurance for fresh perishable foods. Despite the rapid surge in consumer demand for fresh foods, especially in urban areas, the supply and distribution channels have undergone remarkably little change: consumers still predominantly shop at traditional wet markets, food chains are highly fragmented, with underdeveloped food logistics. Increasing demand for fresh foods, combined with persistent traditional methods of moving and distributing foods, have resulted in significant food losses, unsafe foods, negative environmental impacts, and public health threats. In order to develop efficient, sustainable, and safe food chains, Vietnamese cities need to overhaul their market infrastructure and improve the governance around food chains through regulatory coordination. Generating sufficient demand for safe and traceable food, through raising awareness among consumers and building trust in the system is also important, as greater demand would mean a higher willingness-to-pay for safer food, which would then create greater demand for sophisticated transportation and logistics services for food, such as cold chain transportation and storages.

Related to the above specific concerns around food chains, Vietnam's logistics service providers, especially those serving domestic markets, are still small in scale and have much room to embrace technologies to improve their efficiency. The trucking sector, which is among the most critical players in the logistics sector, is highly fragmented with about half of the companies generating annual revenues of around US$0.5 million. In a national survey, truck operators reported that about 60 to 70 percent of the time, their trucks return empty. Underdeveloped non-asset-based brokerage and intermediary services, along with limited automation and use of technology further constrain the ability of the trucking sector to consolidate cargo efficiently.

Together, the state of logistics services and the emerging trends of e-commerce signify new connectivity needs. E-commerce is growing rapidly in Vietnam and offers opportunity for growth, as it can improve productivity and lower the search and transaction costs, both for producers and consumers. Still at an early stage of growth and dominated by small and medium-sized enterprises (SMEs), the sector would benefit from a more enabling environment. Along with all its potential benefits, e-commerce has led to growing needs for new types of logistics services, involving door-to-door connectivity, last-mile delivery, and urban storages that can meet the demand yet provide proximity. All of these bring additional challenges in fast-growing, congested cities in Vietnam, which are faced with competing urban mobility needs, namely between daily commutes and urban freight transport. Considering the various stakeholders with competing needs, solving urban logistics in Vietnam's already built-up and congested large cities is complicated and would require creative and complex solutions involving urban commuters, cargo owners, businesses in urban areas, and logistics service providers.

Delivering on "Last-Mile" Inclusion

Vietnam has achieved remarkable near-universal access to all-weather roads, connecting more than 10,000 commune centers. Nevertheless, with a vast spatial disparity across the pockets of very remote areas remain with limited economic opportunities, other than subsistence farming. Based on the the GSO-WB poverty line, the incidence of poverty in 2016 ranged from approximately 1 percent in the Southeast region to 24 percent in the Central Highlands region and 28 percent in the Northern Mountainous region. Median household incomes are lower and poverty is more concentrated in the remote and low-density population parts of Vietnam offering limited productive opportunities. Limited access to off-farm opportunities accounts for much of the income differences across regions, mirroring the spatial variation in the economic structure within the country. Average incomes are significantly lower in high mountain communes—especially in the non-farm wages, households' businesses, and remittances categories.

In order to understand and quantify the relationship between connectivity and economic outcomes at both the individual household and commune levels, we introduced and calculated a "market access index," a composite indicator that captures transport costs between consumption and production locations in all potential trading districts. In all communes around Hanoi and Ho Chi Minh City, market access is significantly greater; nevertheless, access improved for all communes between 2009 and 2017. Our analysis shows that market access is very strongly correlated with access to off-farm opportunities in lagging areas, more strongly than ethnicity. Improved market access also mitigates the disadvantage of low population density and is associated with higher wage-participation for

wives than their husbands, highlighting the potential for improved market access to reduce gender disparities in wage-job participation. The analysis shows the improvements in transport infrastructure increased market access, which in turn increases wages and attracts more population.

During the last decade, the travel time and transport costs from most localities of Vietnam to major urban areas and international gateways has reduced significantly, thanks to the expansion of the transport network and improvement of road conditions. Over the period from 2009 to 2017, improvements in connectivity have raised national welfare and real incomes for all communes. For instance, welfare benefits result from increases in domestic trade within the country due to reduction in travel time. Connectivity improvements from 2009 to 2017 have slowed down the concentration rate of workers in the main two urban poles, benefiting more distant areas in the Northwest and along the coastline.

We also tested the potential impacts of future connectivity improvements on national real income and spatial inequality, under two scenarios: the first focuses on upgrading or rehabilitating national highways mostly in remote areas and near border-crossing points, while the second completes the planned North–South Expressway. The results show that the national real income would rise under both scenarios, due to improved access to domestic markets and better integration with global trade opportunities. The income effects would be larger for the North–South Expressway, although such investments could worsen the spatial inequality. Both scenarios estimated inequality would be reduced with no barrier to labor mobility, that is, the unhindered movement of workers to take advantage of better economic opportunities created through connectivity improvement.

Building Resilience

Vietnam's extensive transport network is exposed to various hazards, including landslide, fluvial (river) flooding, typhoon, and flash flooding, all of which are increasing in intensity and frequency due to climate change. With 60 percent of its land area and 71 percent of its population exposed to risk, Vietnam ranks high as a natural disaster hotspot of two or more multihazard events, which could result in annual average asset losses amounting to 1.5 percent of GDP and loss in consumption amounting to 2 percent of GDP.

With events of extreme intensity expected to become more frequent due to climate change, Vietnam's major sea, air, and river ports are similarly exposed to natural hazards and thus to the risks of major flow disruption. The potential economic impacts of disruptions related to natural hazards could be significant, accounting for increases in transport costs of rerouting and reduction in production due to input–output linkages of goods moved on the affected transport link. Some transport links, which carry significant traffic with few rerouting options, are estimated to incur substantial economic losses if disrupted by an extreme event—as high as US$20 million—a value many times greater than the cost of rebuilding the asset.

Our analysis suggests that upfront investments to upgrade and rehabilitate existing assets, focusing those that are economically critical, are well justified. Climate-resilient investments in some of the most critical transport links would bring benefits—in terms of avoided future disruptions and resultant economic losses—far exceeding their costs. Expected future climate change impacts would

justify more investments, as the benefits would be greater for the network section most negatively affected by climate change.

We found that multimodal transport could be a resilient strategy in that less reliance on one mode would reduce the expected economic losses. Building truly multimodal connectivity, however, is a challenging task that would require improvement in infrastructure, regulatory framework, market incentives, and development of logistics services. Currently, the key bottlenecks preventing Vietnam from achieving efficient multimodal connectivity include (a) the lack of containerization on inland waterway transport, (b) underdeveloped river ports with poor land connectivity and rudimentary cargo handling equipment, and (c) underutilized potential of domestic coastal shipping constrained both by infrastructure and market structures. Overcoming these roadblocks to achieving a more resilient transport system in Vietnam would require concerted efforts across multiple stakeholders.

For better connectivity for Vietnam, we propose actions around nine key recommendations:

1. Re-orient transport and spatial planning to support critical value chains. Transport planning and investment strategies need be informed by value chain criticality, so that connectivity can best serve Vietnam's further integration with the global markets. At present, trade information, especially on value chains, is rarely used in policy formulation or infrastructure investment decisions. In order to mainstream such practices, *the entire eco-system of trade and transport links needs* to be created, including systematic collection of relevant trade and transport data, a system where such data are consolidated and analyzed, and procedures by which the analytical outputs have tangible influence over the planning and investment decision processes. The ongoing efforts by the Ministry of Transport (MoT) to establish the Vietnam Logistics Statistical System need to be completed and further built upon.

2. Reconfigure the network of international gateways. Vietnam should address the capacity bottlenecks, congestion, and demand-supply imbalance at its international gateways, while offering flexibility to accommodate the evolving structure of its trade. As Vietnam's trade grows, capacities at its largest international gateways grow increasingly constrained, while several gateways face serious inland connectivity issues. To address these challenges, Vietnam needs to further develop new gateways with greater capacity and efficiency (in the case of the planned Long Thanh airport and Lach Huyen seaport), while improving coordination across the central and provincial governments in ensuring hinterland connectivity of main gateways. Moreover, we recommend considering these critical gateways as a network with complementary roles and discouraging wasteful competition among various localities. Consolidation at gateways with the structure and capabilities to handle intercontinental vessels, supported by good domestic shipping and land connectivity, is beneficial for importers, exporters, and shippers alike, as such an arrangement can significantly lower transit time and reduce trade costs with some of Vietnam's major trade partners.

3. Create "economic densities" along new corridors. Vietnam's newly developing high-capacity high-speed connective infrastructure provides unique opportunity to reduce "economic distances" while creating "economic densities." Both outcomes can be achieved by allowing targeted

development around "high value" transport nodes created around new infrastructure, such as expressways. Economic clusters, such as industrial parks (IP) and economic zones (EZ) have been instrumental in economic agglomeration. However, signs indicated some of them have reached a point where congestion would lower the returns on further agglomeration and concentration. Land-use plans around these critical national connective infrastructures, while under the responsibility of respective provincial authorities, should be coordinated so as to give incentives for productive high-density use of lands that can generate jobs and reap the benefits of good connectivity.

4. Upgrade connectivity "software" to serve domestic markets. Vietnam's logistics service providers (LSP) are fragmented and small in scale. For instance, an average truck operator in Vietnam employs three people and generates an annual turnover of around US$0.5 million. While LSPs serving the foreign direct investment (FDI) sector expand and become more sophisticated, domestic trade is still primarily served by rudimentary services. With a growing number of urban consumers increasingly demanding competitive prices along with higher standards of services, such as safety, punctuality, freshness, and traceability of traded goods, this presents an opportune moment for growth of LSPs serving the domestic markets. The government can support this private-sector-driven development by creating an enabling regulatory environment, enforcing standards, and "nudging" the consumers to support a competitive market, accomplished through raising awareness around safe food chain, employing policies to support upscaling the LSP and bringing in new technologies, and encouraging creation of brokerage and intermediary services, including third-party or fourth-party logistics.

5. Overhaul market infrastructure and logistics in cities. Vietnamese cities should upgrade, and in some cases relocate, their market infrastructure, which is predominantly outdated and in traditional forms (for example, wet markets). Currently, with few exceptions, matters of needs, risk and performance of food system and other urban consumption activities are not mainstreamed into urban land-use planning, logistics, environmental management or overall municipal governance. And, in most agricultural strategies and plans, cities are identified as end points for consumption, but not as active, responsible players in governance of supply chains including for food. Moreover, consideration for urban logistics is often omitted in the current practices of transport planning in major urban areas. Logistics facilities of various hierarchy, such as inland container depots, cargo handling facilities at critical interurban connection points (railway stations, domestic airports, and ports, for instance), urban distribution centers, and small warehousing in urban areas, should be brought into the domain of the formal transport planning process, to ensure efficient movement of goods for the businesses and consumers alike, and without negatively affecting the urban environment and livelihood.

6. Connect low-density communities to markets. Vietnam should continue providing connectivity for remote and low-density areas of the country,[3] to reduce economic distance and improve market access for all localities, by connecting them to main economic corridors rather than nearby, similarly low-density adjacent localities. Our empirical analysis provides evidence that connectivity brings more employment opportunities, greater wages, better opportunities to participate in domestic and international trade, and thus improved welfare. We also found that connectivity can offset the negative impacts of low density on employment potential and wages, and thus, providing connectivity proves even more critical for low-density communes in the country.

7. Complement connectivity with social and economic support. Vietnam should employ complementary policies such as lowering barriers to labor mobility and providing universal access to quality education and health, in parallel with the investments and policies for connectivity improvement. Our analysis shows that with no constraints to labor mobility, improved connectivity will reduce spatial inequality. By facilitating free movement of people to locations that offer opportunities for better jobs and higher wages—thanks in part to better connectivity—the economy as a whole can maximize the benefits of improved connectivity. At the household level, while good market access strongly correlates with positive economic outcomes (accounting for 30 to 34 percent of the gaps in off-farm employment across different geographical locations and ethnicities), the remaining gaps could be explained by other factors, such as education attainment and agriculture related endowments and resources. Therefore, to be sufficient for inclusive welfare increase for all populations in Vietnam, improved connectivity should be accompanied by complementary policies.

8. Invest in "smart resilience" based on criticality and risk. Vietnam should build resilient and reliable connectivity in face of increasing intensity and frequency of natural hazards. Our analysis estimated the potential substantial economic loss on connective infrastructures caused by natural hazards, considering not only the costs of damage recovery, but also the economy-wide impacts on value chains due to flow disruptions. Located along coastal lines, mountainous areas, or flood-prone terrains, Vietnam's critical transport links are highly vulnerable to various climatic events, therefore justifying significant upfront investments to strengthen their resilience and reduce their vulnerability—even more so under climate-change scenarios. Investments in resilient and reliable connectivity should therefore mainstreamed through the rigorous collection and analysis of multisector data on infrastructure, meteorology, hydrology, and geology. Given the limited resources for maintenance and upkeep of the existing transport network, such investments on resilience and reliability should be carefully prioritized on the basis of criticality, considering the traffic volume, costs of rerouting, and availability of alternative routes.

9. Promote multimodal transport as a resilient strategy. Vietnam's economic activities rely heavily on its increasingly congested road network, part of which is vulnerable to natural disasters. At the same time, Vietnam's natural endowment such as an inland waterway network and long coastal lines, is underutilized and not fully explored. Multimodal transport therefore makes a good connectivity strategy, both in terms of transport costs and resilience of connectivity. Our geospatial analysis supports this argument: Even a modest modal shift from road to waterborne transport—economically beneficial given the lower transport costs of the latter—would reduce risk exposure and improve resilience of the overall transport network. Limitations in infrastructure development, regulatory framework, market incentives, and behavioral inertia present challenges to achieving true multimodal connectivity. Vietnam needs to address the most critical barriers to multimodality—including the lack of containerization in inland waterway transport—combined with the underutilized potential for coastal shipping and the lack of well-connected and well-equipped river ports to facilitate transshipment and handling of container- on-barges.

NOTES

1. The 12 border gates include the following: Noi Bai airport, Tan Son Nhat airport, Ho Chi Minh City seaport complex, Hai Phong seaport complex, Vung Tau seaport complex, Cai Lan seaport (Quang Ninh province), Tien Sa seaport (Da Nang City), Lang Son border-gate complex, Quang Ninh border-gate complex, Lao Cai border-gate complex, Quang Tri border-gate complex, and Tay Ninh border-gate complex.

2. These nine value chains are textile and garments, leather and footwear, electronics, wood products, rice, aquaculture, coffee, rubber, and vegetables and fruits.

3. Population density in Vietnam ranges from 33.8 individual/km^2 in high mountains and 84.9 in low mountains, to 151.2 in hills, 214.4 in coastal regions, and 257.1 in inland delta areas. The first two would be considered low density.

CHAPTER 1

Vietnam
The State of Connectivity

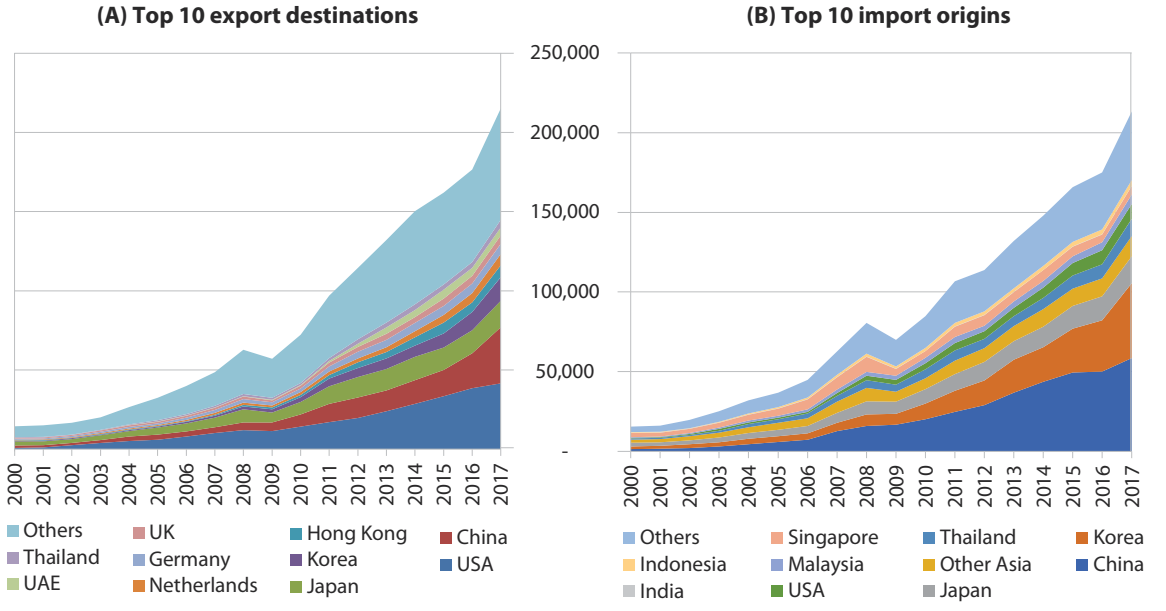
Jung Eun Oh, Duc Minh Pham, and Charles Kunaka

Vietnam is a fast-growing, vibrant economy located in Southeast Asia. Its export has grown at an annual average rate of over 14 percent during the past five years—nearly five times faster than the global average during the same period—urban population is growing at over 3 percent per year, with about 70 percent of Vietnamese households in the "consumer class." This introductory chapter provides an overview of Vietnam's connectivity context, both at and within its borders, and outlines the objectives and structure of this report.

Vietnam's International and Regional Trade

With a trade-to-GDP ratio of 190 percent in 2018, Vietnam is among the world's most open economies. The country has made remarkable achievement in trade liberalization through the removal of both tariff and non-tariff barriers and fulfilling its commitment in several regional trade agreements. Vietnam entered ASEAN Free Trade Area (AFTA) in 1996, the Bilateral Trade Agreement between the United States and Vietnam (US-BTA) in 2000, the World Trade Organization (WTO) in 2006, and the Comprehensive Progressive Trans-Pacific Partnership (CP-TPP) in 2017. As of 2017, Vietnam's top five export destinations, in the order of export value—the United States, China, Japan, Republic of Korea, and Hong Kong SAR, China—comprise more than 52 percent of Vietnam's total exports. The top five import partners: China, Republic of Korea, Japan, other Asian countries, and Thailand account for nearly 70 percent of its total imports (see figure 1.1). Geographically, Vietnam's major trade partners are located mostly in North America, Northeast Asia, and Europe.

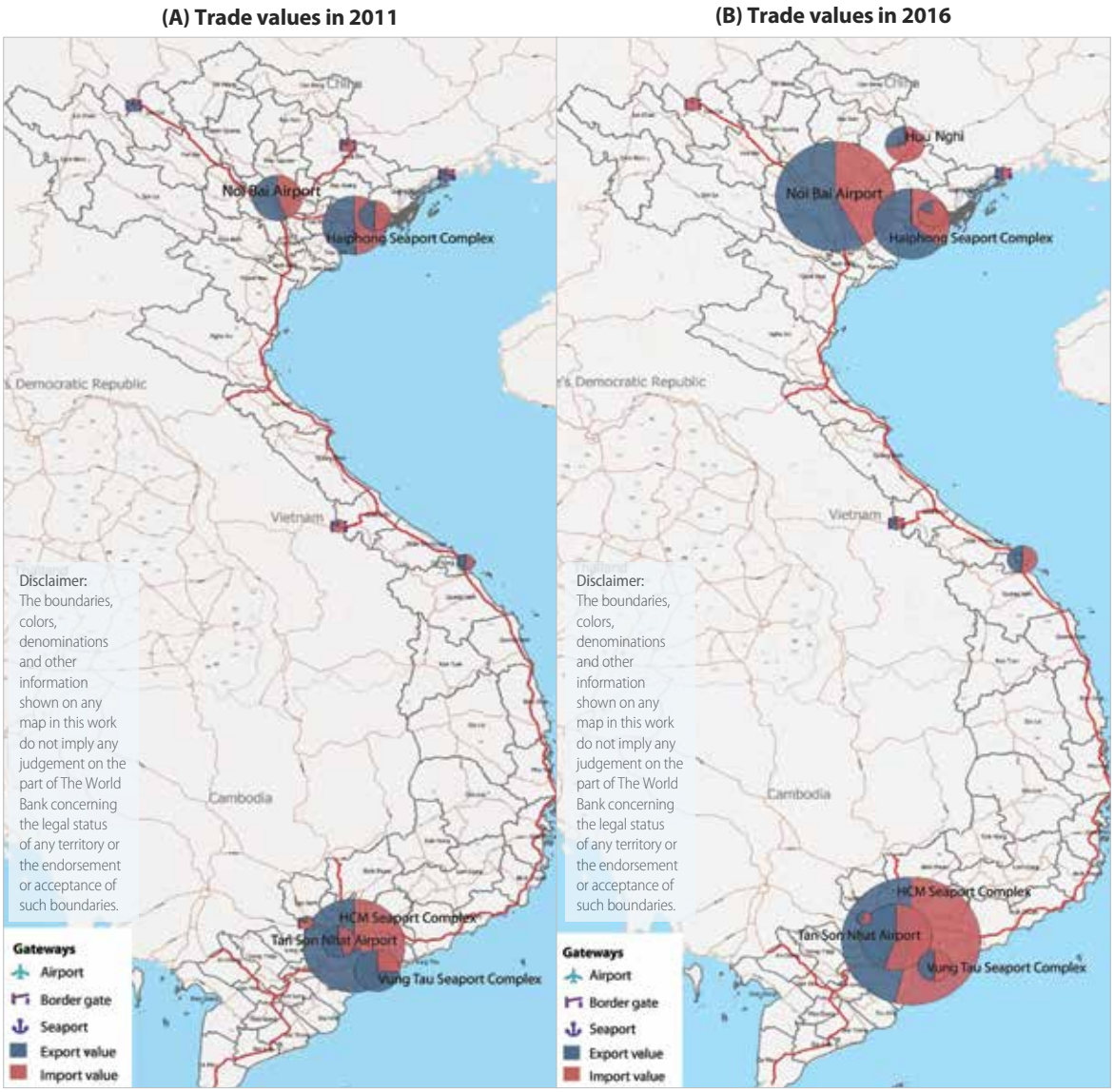
FIGURE 1.1. **Vietnam's Trade Growth Trajectory by Trade Partners**



Source: UNComtrade database, available at https://comtrade.un.org/.

Vietnam's trade activities are concentrated at twelve of its 48 border gates, including two airports, five seaports and five border crossing points, which collectively handled 91 percent of total trade value in 2016 (see figure 1.2 and figure 1.3). Vietnam's major trade partners are reached mostly by sea or air. Trade activity with bordering neighbors is limited; trade across border-crossing points is minimal except for the northern borders with China, which has seen growth in recent years. As seen in figure 1.2 and figure 1.3, seaports and airports near the major economic centers in the north and south play important and increasing roles. As the trade grows, congestion at and near these international gateways and border-crossing points also increases. For instance, the road network around Ho Chi Minh City (HCMC) port complex, especially Cat Lai port, is among the most congested part of the road network around HCMC.

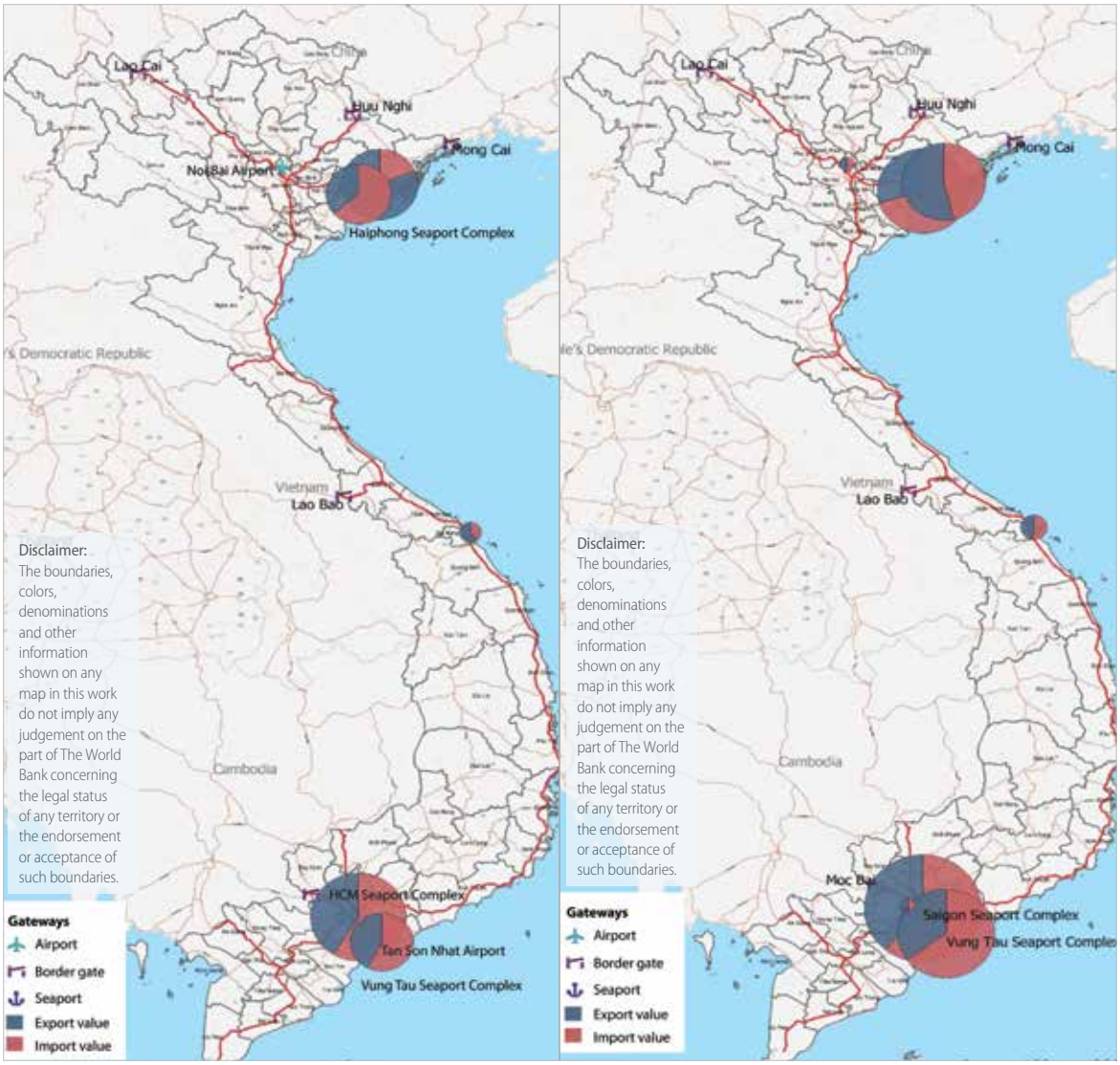
FIGURE 1.2. **Vietnam's Trade at its Major Border Gates in 2016**



Source: World Bank estimates based on data provided by the General Statistics Office and General Department of Vietnam Customs.

FIGURE 1.2. **Continued**

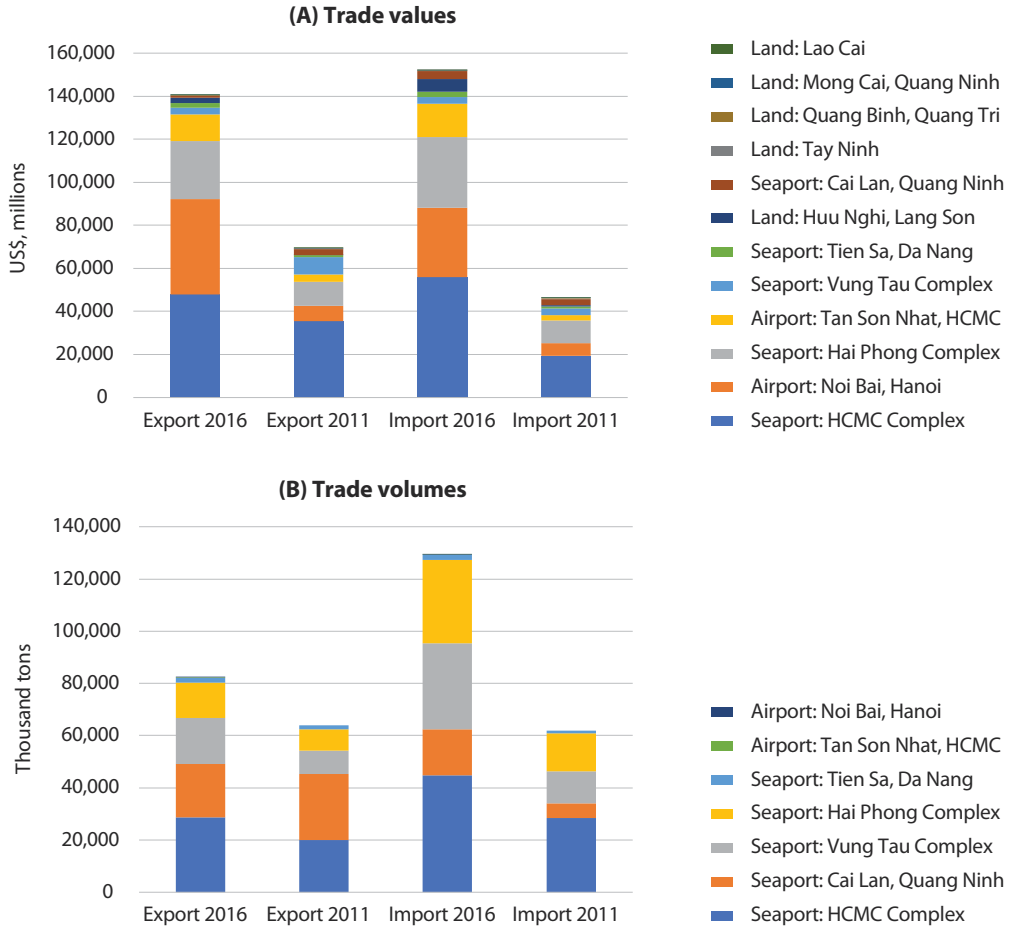
(C) Trade volumes in 2011 **(D) Trade volumes in 2016**



Source: World Bank estimates based on data provided by the General Statistics Office and General Department of Vietnam Customs.

Comparing trade values, volumes, and change from 2011 to 2016, we see the role of Vietnam's two major airports expanding drastically, handling high-value, time-sensitive cargo. In fact, these airports serve as key gateways for major foreign direct investments (FDIs) around Hanoi and HCMC, which are part of global value chains (GVC) and rely on import of high-value inputs for assembly and export of final products. In terms of volume, the key seaports also play major roles. In addition to the two busiest ports in HCMC and Haiphong, the relatively new Cai Mep Thi Vai (CMTV) port in Vung Tau, which can handle much larger vessels than any other ports in Vietnam, plays an increasingly critical role.

FIGURE 1.3. **Vietnam's Trade at Its Major Border Gates in 2011 and 2016**



Source: World Bank estimates based on data provided by the General Statistics Office, General Department of Vietnam Customs, and Ministry of Transport.

While Vietnam's most important trade partners include the United States, European Union, and several East Asian economies, **the regional trade connectivity with its closer neighbors in Southeast and South Asia is emerging as an increasingly critical agenda.** The regional connectivity agenda can be considered at different scales, to reflect the diversity of needs and the nuances of different supply chains. These scales include connectivity within the immediate Southeast Asia neighborhood, and the evolving and expanding links with China as well as to South Asia.

Deepening intra-ASEAN connectivity is among the ongoing priority trade initiatives for Vietnam. Vietnam has a long history of cooperation on connectivity within the sub-region, through its participation in the Greater Mekong Subregion (GMS) initiative, launched in 1992 by Vietnam and five other riparian states of the Mekong River (Cambodia, China, Lao PDR, Myanmar, and Thailand). The program, still under implementation, focuses on cross-border infrastructure development in a few priority economic corridors with the goal of enhancing economic cooperation among the participating economies. While some of these corridors are lightly traveled, the GMS region's basic core infrastructure could support further trade integration.

Another, potentially more consequential regional connectivity initiative involving Vietnam is the Association of Southeast Asian Nations (ASEAN) Master Plan for Connectivity (MPAC 2025), which includes all ten economies in the ASEAN. Trade with other ASEAN economies accounts for 25 percent of Vietnam's trade, just higher than the 23 percent average for all ASEAN economies (ASEAN Secretariat 2018). Growth in ASEAN has been driven by regional value chains, comprised of trade in tasks across the region. Improvements in connectivity have underpinned and shaped the regional integration agenda. However, important gaps in connectivity remain. For instance, at the ASEAN level, estimates place the requirements for infrastructure improvements at more than US$110 billion a year, at least double the amount that the ASEAN member states have historically spent on infrastructure (World Bank 2019a).

MPAC 2025 is intended to guide the development of infrastructure for further integration within ASEAN. The short-term priorities for Vietnam and its ASEAN neighbors focus on completing the core regional network, such as highway corridors between Vietnam and Cambodia or Lao PDR. The medium-term agenda includes establishing new highway or railway connections between these countries, along the corridors with increasing trade volume. For instance, in recent years, Vietnam's National Highway 22 between Ho Chi Minh City and the Moc Bai border gate to Cambodia has seen traffic growth at more than 7 percent per year (World Bank 2019a). Improvement of these corridors, and the resulting time savings will become increasingly important across the ASEAN region as the region upgrades to predominantly higher value goods. Therefore, participating countries must approach the core regional network development, consisting of these critical trade corridors, in a coordinated manner. Ultimately, the benefits of connectivity will be maximized when a network is appropriately interconnected, especially by completing links between the most important nodes.

The Belt and Road Initiative (BRI), a large-scale initiative that focuses on enhancing global connectivity, may present opportunity for Vietnam to leverage its potential. Vietnam is one of more than seventy countries participating in the BRI. Vietnam is part of the China Indochina Peninsula Economic Corridor (CICPEC) intended to enhance connectivity between the following key cities: Nanning (China), Hanoi, Vientiane (Lao PDR), Ho Chi Minh City, Phnom Penh (Cambodia), Bangkok (Thailand), Kuala Lumpur (Malaysia), and Singapore. Recent estimates by the World Bank (World Bank 2019b) suggest that trade costs for East Asia economies would fall from implementing BRI-associated projects and trade facilitation measures. The CICPEC has several new already operational links, with others under construction or active consideration, including the new railway line under construction between China and Lao PDR. This new railway connection will interconnect with the Thailand system, and could potentially be interlinked via a Vietnam–Cambodia railway link and to a proposed high-speed railway in Vietnam between Hanoi and HCMC. While the feasibility of such a significant undertaking should be carefully assessed, a network-level assessment suggests that completing these core BRI networks could enhance the centrality and importance of Hanoi and Ho Chi Minh City in the network of cities in Southeast Asia (Derudder, Liu, and Kunaka 2018). An increase in centrality will make the center more attractive for investment and as traffic intermediation nodes in the region.

While the infrastructure improvements are ongoing, logistics operations have been initiated along segments of the main corridors, such as the train container services between China and Vietnam. The introduction of block-train container services between China and Vietnam have helped to reduce goods shipping costs between the two countries and reduced some past constraints encountered with individual wagonload traffic (Bullock, Liu, and Tan 2019). Sending freight across borders in individual wagonloads often meant long delays waiting for connections, and especially for other processes such as transshipment or customs inspections. Block container services have proven much cheaper, especially from same origin to same destination. This outcome points to the importance of consolidating regional traffic at a handful of nodes and along a few cross-border routes.

The effects of border procedures and attendant delays are most visible with road transport, which incur significant amounts of time and costs. Table 1.1 shows a cost comparison of shipping goods in a container by road and rail, and over similar distances between China and Vietnam.[1] The costs of shipping by road are more than double the estimated costs of using rail transport. Partly for this reason, the CICPEC participants prioritize the development of railway transport as the backbone of the connectivity initiative under BRI.

TABLE 1.1. **Land Transport Prices Vietnam–China Border, February 2018**

		Unit	Thang Long – Lang Son (Road)	Yen Vien – Dong Dang (Railway)
Distance		Km	160	160
Costs	Container transport	US$	457	202
	Non-transport container cost		101	0
	Road user fee		9	0
	Checkpoints		18	0
	Loading and unloading[a]		66	53
	Transshipment		53	53
	Border gate road fee		35	0
	Customs		74	71
	Total		**786**	**391**

Source: Bullock, Liu, and Tan 2019.
Note: a. Transloading of truck loads occurs at the border. The costs in table 1.1 represent the Vietnam leg only and exclude administration and transport costs within China.

Improving connectivity to South Asia and beyond—not only via the current sea and air transport routes, but also by land—could present added opportunity for Vietnam. Trade between the ASEAN region and South Asia has been growing strongly in recent years and has the potential to continue growing (table 1.2). In South Asia, India is the most important trade partner. India's major exports to ASEAN are primarily petroleum and agricultural products, whereas the major imports include telecom products, electronics, automobile parts, and components, with additional import activity focusing on edible oil, coal, and petroleum oils. Most of India's exports to ASEAN countries have been directed to Vietnam, Singapore, Malaysia, Indonesia, and Thailand, while sourcing imports mostly from Indonesia, Singapore, Malaysia, and Thailand.

TABLE 1.2. **Trade between India and ASEAN**

Country	Export (US$, billions)		Import (US$, billions)	
	2010-11	2017-18	2010-11	2017-18
ASEAN (all members)	23.02	34.20	29.68	47.13
Vietnam	***2.49***	***7.81***	***1.00***	***5.02***
Brunei	0.02	0.06	0.21	0.43
Cambodia	0.06	0.12	0.01	0.06
Indonesia	4.57	3.96	9.72	16.44
Lao PDR	0.01	0.03	0.02	0.17
Malaysia	3.55	5.70	6.00	9.01
Myanmar	0.27	0.97	1.12	0.64
Philippines	0.80	1.69	0.40	0.76
Singapore	9.09	10.20	7.27	7.47
Thailand	2.14	3.65	3.95	7.13

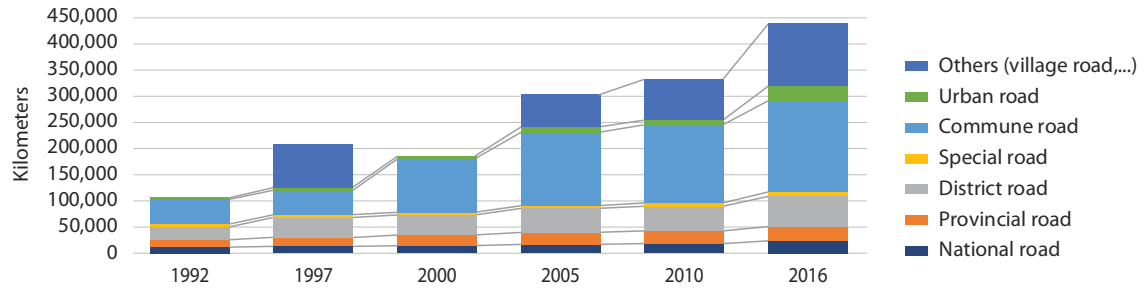
Source: De 2018.

For Vietnam, the current trade patterns with India have two implications: First, the need to work with neighboring countries, if overland trade with South Asia is to grow; and second, the importance of implementing policy measures to reduce trade costs. Vietnam has long leveraged the benefits of trade policy reforms to enhance trade connectivity, drawing on a strong and prominent policy and institutional dimension to connectivity, and building on WTO membership, trade liberalization, and a cut in tariffs. In addition, Vietnam also signed several trade agreements that opened access to new market access. More recently, the country has pursued deeper integration with ASEAN partners, participating in larger agreements, such as the Comprehensive and Progressive Agreement for Trans-Pacific Partnership and agreements with the European Union. However, the ability to realize the full potential of the various agreements is hampered by a proliferation of complicated and burdensome non-tariff measures (NTMs) constraining trade.[2] Thus, streamlining of NTMs is important for facilitating preferential market access between Vietnam and some new markets, especially South Asia.

Vietnam's Transport Network

Within the mainland Vietnam, the transport network has undergone significant expansion over the past decades, improving the connectivity of all localities in the country to these international gateways. Most remarkable development in network expansion occurred in the road sector. The total length of the road network, excluding village roads, more than tripled since 1992, reaching over 300,000 km as of 2016 (figure 1.4). As a result, the number of commune centers without access to all weather roads decreased from more than 600 in 1997 to 65 in 2016.

FIGURE 1.4. **Expansion of Road Networks**



Source: Ministry of Transport of Vietnam.

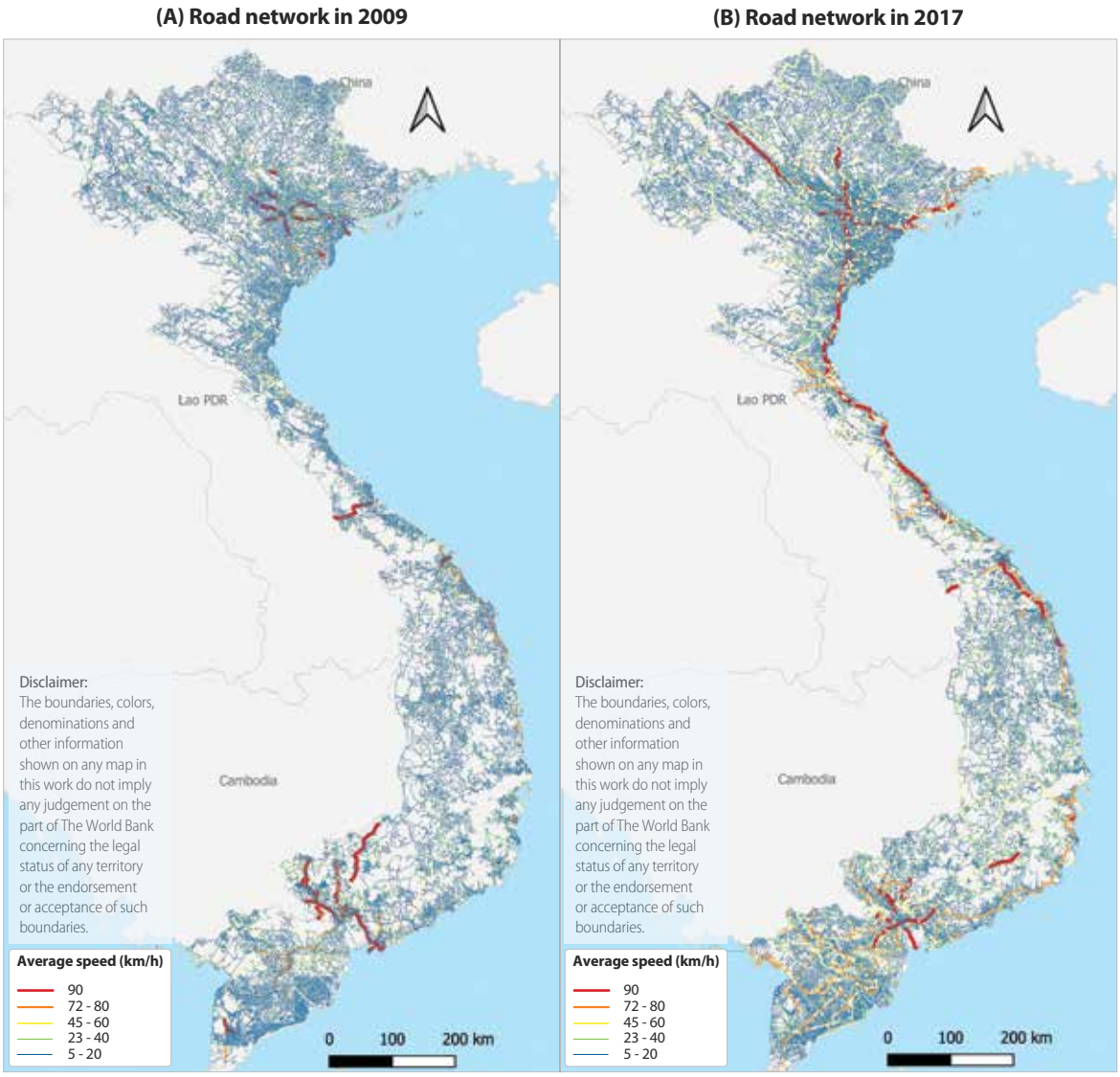
Expansion of the road network has shortened the economic distance for many parts of the country, notably the development of about 1,000 km of expressways—part of a fully access-controlled toll road system—during the past decade. The two maps shown in figure 1.5 depict the expansion of improvement in travel speed on Vietnam's road network in 2009 and 2017. Vietnam's main road network has evolved not only in terms of quantity, but also in the quality and condition measured by average speed (from 13.32 km per hour to 14.11 km per hour), as shown in table 1.3 and figure 1.5.[3]

TABLE 1.3. **Road Network Used for Mapping and Analysis**

Road type	In 2009			In 2017		
	Length (km)	Avg speed (km/h)	Road density (km/km²)	Length (km)	Avg speed (km/h)	Road density (km/km²)
Expressway				967	100.00	0.003
National highways	15,068	35.67	0.045	20,144	41.61	0.060
Provincial road	17,491	26.12	0.052	21,709	28.51	0.065
Other roads	156,826	11.95	0.469	205,898	12.58	0.615
Total	189,385	13.32	0.566	248,717	14.11	0.743

Source: World Bank's GIS work using data from Directorate for Roads of Vietnam (DRVN).

FIGURE 1.5. **Extent and Travel Speed of Mainland Vietnam's Road Network in 2009 and 2017**



Source: World Bank's GIS work using data from DRVN.

Development of Vietnam's non-road transport network has been less pronounced, yet is important to note.

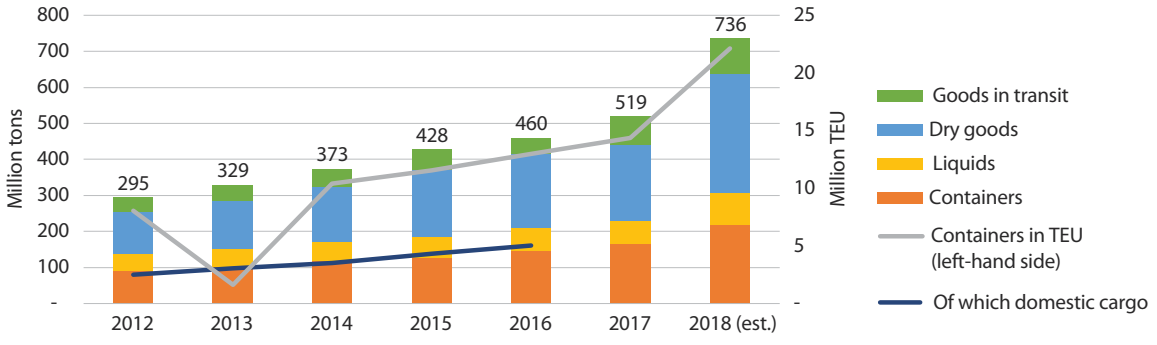
Vietnam is endowed with an extensive network of natural waterways, and its inland waterways transport (IWT) carries significant traffic mainly around the Red River Delta and Mekong Delta areas. However, of the nearly 16,000 km of managed navigable waterways, only around 15 percent (about 2,600 km) can reliably handle barges of more than 300 deadweight tons (DWT).[4] Similarly, while Vietnam has plentiful ports and landing stages—254 ports and over 4,000 landing stages on the national waterway network as of 2017—the terminal infrastructure and equipment are mostly rudimentary.

Many ports rely on outdated, unmechanized, and inadequately maintained handling facilities that are poorly connected to hinterlands, which renders most ports underutilized compared to their potential capacities. In turn, only about 11 IWT ports in the northern region and about 18 in the southern region handle significant volumes of cargo. Except for a few landing stages improved through private-sector investments for the use of specific commodities, most landing stages are quite rudimentary, requiring manual loading and unloading of cargo to the river or canal bank.

Largely unchanged over the past decades, Vietnam's railway network has a route length of 2,609 km, with total trackage of 3,300 km. The century-old railway network, mainly single-track, non-electrified meter-gauge with an axle load of 14 tons, consists of seven principal routes, with the main north–south link joining Hanoi with HCMC. In northern Vietnam a network of lines links Hanoi with the port at Haiphong, as well as two lines to border crossings with China at Dong Dang and Lao Cai. In addition to the public network, industrial rail systems, with a total length of 120 km, primarily serve mineral and industrial enterprises undertaking their own operations. The Vietnam railway system currently carries about 10.5 million passengers (or 4 billion passenger-km) and 5.5 million freight tons (or 3.9 billion ton-km) annually. With volumes remaining mostly constant for the last several years, railway accounts for under 5 percent of the country's total movement of goods and people.

Vietnam's extensive seaport system includes 45 ports and nearly 200 terminals. Maritime cargo throughput has continued to increase, as has the share of domestic throughput via coastal or short-sea shipping (see figure 1.6). As illustrated in figure 1.3 above, the two seaport complexes in the north (Haiphong) and in the south (HCMC) serve as the primary international gateways and handle much of the country's trade volume. These ports operate at or near capacity, with limited room for capacity expansion due to their confined locations within built-up urban areas. Traffic congestion around the Haiphong and HCMC ports and the connecting national highway systems exacerbates delays in cargo movement and negatively affects urban mobility in these major cities.

FIGURE 1.6. **Growth of Maritime Cargo Throughputs in Vietnam**

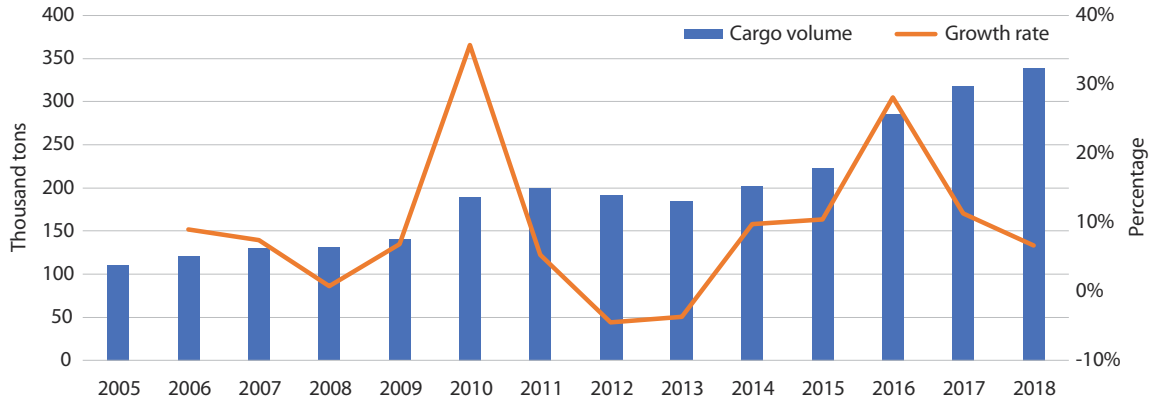


Source: Based on 2018 data provided by the Transport Development Strategy Institute and the Vietnam Maritime Administration.
Note: Volumes in 2018 estimates are based on first quarter data.

Located near Vietnam's existing international gateways, newly developed deep-sea ports aim to improve efficiency of port operation by handling large mother vessels, thereby relieving congestion at the existing ports located in urban areas. Vietnam's first deep-sea port, the Vung Tau seaport complex, lies approximately 50 km south from the existing HCMC port complex, has been developed to handle up to 180,000 DWT vessels. However, the container volume handled in this port complex is far below its capacity due to the inadequate hinterland connectivity by land and IWT. In the northern part of the country, the first container terminal at the Lach Huyen deep-sea port in Haiphong, further east from the existing Haiphong Complex, started operating in 2018. Several other deep-sea ports have opened as well, including Tien Sa in Danang and Cai Lan in Quang Ninh province. The remainder of Vietnam's maritime ports lack the deep water terminals, specialized handling equipment, and quays with sufficient length to handle large ships above 50,000 DWT.

Vietnam's aviation sector has seen rapid growth in the recent years, both in passenger and freight segments. Vietnam's air freight has grown at an average rate of 10.8 percent per year from 2009 to 2017, and is set to continue to grow at a rate above 6 percent per year in the near future (figure 1.7). Air cargo transportation accounts for about 25 percent of Vietnam's export and import value. Major international air cargo routes in Vietnam include Asia-Pacific, European Union, and North America; China is currently Vietnam's largest air cargo import market with a 26 percent market share, followed by the Republic of Korea (20 percent) and the United States (9 percent). Infrastructure in the aviation sector is under development. Among the 22 airports in Vietnam, only four—Noi Bai (Hanoi), Danang, Cam Ranh (Khanh Hoa province), and Tan Son Nhat (HCMC)—have separate cargo terminals, and two—Noi Bai and Tan Son Nhat—have onsite logistics centers. The remaining airports do not have cargo terminals and handle their cargo in passenger terminals.

FIGURE 1.7. **Growth of International Air Freight Volume in Vietnam**

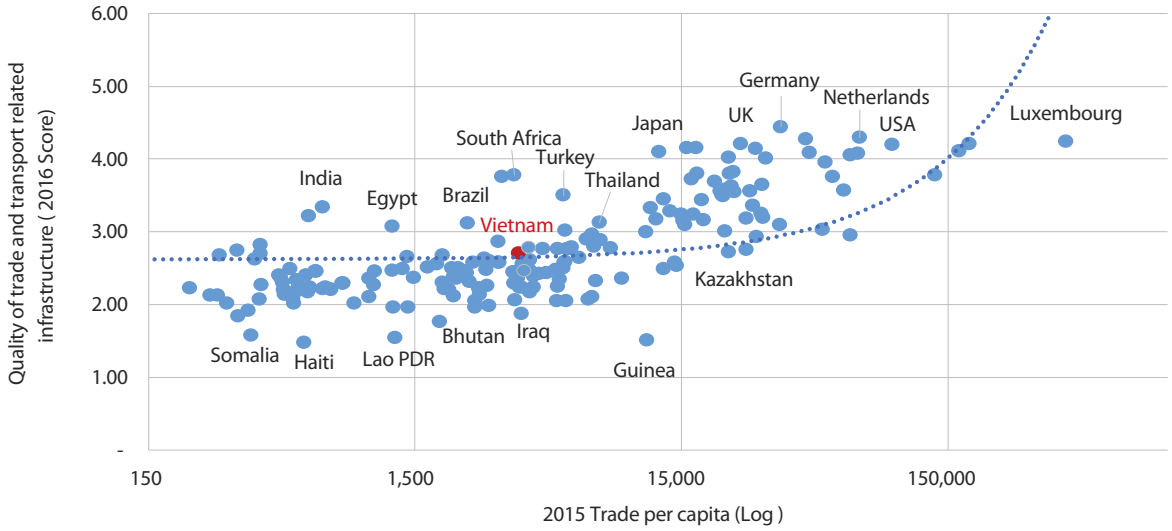


Source: Based on data provided by the General Statistics Office and the International Air Transport Association (IATA).

Considering the above development, the quality of Vietnam's transport and logistics infrastructure appears to have not reached its full potential compared with its level of development. Figure 1.8 provides an international comparison of the quality of trade- and transport-related infrastructure against trade development measured by trade per capita. Vietnam earned a score of 2.7 on quality of trade-related infrastructure for the Logistics Performance Index (LPI) 2016,

roughly equal to the world average (2.75). Vietnam came in lower than the East Asia Pacific average *including high income countries* (3.02), but higher than the East Asia Pacific average *excluding high income countries* (2.58). At the same time, many of its regional peers perform far better than Vietnam in this respect. As Vietnam aspires to reach upper middle-income—at an income level above US$4,000 gross national income (GNI) per capita—avoiding constraint on future growth requires continued improvement of infrastructure quality.

FIGURE 1.8. **Quality of Trade-Related Infrastructure versus Trade per Capita**



Source: World Development Indicators for 2018, available online at: https://databank.worldbank.org/source/world-development-indicators.

Connectivity for Integration, Inclusion, and Resilience

Remaining challenges

Vietnam's story illustrates a remarkable success in integrating with the global economy. It also demonstrates the impressive pace of critical investments made to build much needed connective infrastructure. Based on this, one could argue that Vietnam is doing relatively well in terms of connectivity and is connected to where it needs to be connected, internationally and domestically.

While recognizing successes and achievements, however, we argue the current state of connectivity presents many challenges, both present and future. Behind the rapid expansion of the physical capacity of transport infrastructure is the issue of mismatch between connectivity demand and supply. The overall system heavily relies on road transport, which carries three-quarters of total cargo volumes, with very few multimodal trips due to weak intermodal links. Routes, therefore, are not optimized. In many parts of the network, worsening congestion costs the economy significant productivity losses and causes pollution; meanwhile, other parts of the network remain underutilized, rendering the investments ineffective.

The logistics service sector is bifurcated between the segment serving well-endowed FDIs and their sophisticated needs—mostly through some forms of joint ventures with international players—

and small-scale rudimentary establishments competing on low price rather than service quality. For instance, about half of Vietnam's truck operators employ three or fewer people, generate annual revenues of less than US$500,000, and have little to no ability to invest and scale.

Infrastructure, inadequate both in quantity and quality, is also spatially uneven. Vietnam's high-speed and high-capacity expressway network is still in its very early stage of development, requiring multibillion-dollar investments for completion of the network. With a huge backlog of maintenance and repairs, the safety and efficiency of Vietnam's legacy railway system infrastructure have been seriously undermined. Vietnam's heavy exposure to various types of natural hazard—among them typhoons, flooding, and landslides—means potential serious vulnerability of the built infrastructures and overwhelming needs to ensure resilience. From this global benchmarking, Vietnam's quality of trade and transport-related infrastructure apparently has not been able to keep pace with its trade growth and development. The trade competitiveness potential in Vietnam is constrained by the lack of policy orientation toward promoting trade-oriented connectivity.

The external and domestic changes in Vietnam, including evolving international trade relationships, the country's comparative advantages in global economy, and its rapidly changing patterns of domestic consumption, will have implications on future connectivity needs. Because trade has grown in Vietnam much faster than in other countries, at the current GDP and level of openness, the country might be vulnerable to volatile global trends, especially when considering the recent rise in protectionism and trade tension. This means that in addition to its current strong GVC participation, Vietnam might need to further diversify its trade partners and expand its domestic consumption base.

Connectivity as a lever to achieve *integration, inclusion, and resilience?*

Against the backdrop described above, this report aims to examine the link between connectivity and the critical development goals of Vietnam: *integration, inclusion, and resilience,* which are discussed as follows and depicted in figure 1.9:

FIGURE 1.9. **Connectivity and the Three Development Goals**

The first dimension of *integration* refers to Vietnam's integration with global markets and participation in the global value chains. As one of the most open economies that boasts a high trade-to-GDP ratio and high foreign direct investments (FDI) relative to the size of its economy, integration with the global markets represents a critical factor in Vietnam's continued growth. The recent World Bank report, *Vietnam at a Crossroads: Engaging in the Next Generation of Global Value Chains* (Hollweg, Smith, and Taglioni 2017), notes that Vietnam's connections to international trade networks are good, but less strong than with its neighboring countries, which limits regional competitiveness. The report further notes that poor efficiency of customs clearance, weak infrastructure quality, and the quality and competence of service providers limits logistics and trade facilitation. Vietnam has thus room to develop in regional value chain trade, greater network centrality, participation relative to per capita income, and strengthened forward and backward links. The changing geopolitical relationships among Vietnam's key trade partners and global trade patterns, and these external conditions could have significant impacts on Vietnam's growth potential, its roles in future value chains, and jobs (Cunningham and Pimhidzai 2018). Vietnam's trade and transport connectivity could affect how Vietnam responds to, and influences, the external conditions.

The second dimension of *integration* is that of domestic markets, which consists of rural and urban links and connectivity around and within growing urban areas. Vietnam's urbanization is still very much in progress, both in terms of population and physical footprint of its growing cities. Its expanding middle-class population predominantly resides in urban areas, with their rising incomes and rapidly changing consumption patterns and habits. This richer and more urban population is more reliant on traded consumption than on self-produced consumption. Thus, better domestic connectivity would be needed to serve this growing consumer base, including connectivity for food supply logistics, urban mobility, and the emergent e-commerce sector. Faced with uncertainties and risks around international trade, the "consumer class" and domestic markets in Vietnam provide a new opportunity for its growth, calling for attention to the domestic connectivity issues.

Vietnam's *inclusion* agenda, despite the sharp decline in poverty rate over the past decades, is unfinished. Despite the commendable efforts made by the government to date, spatial disparity across the country remains vast and most of the remaining poverty is concentrated in remote areas and among ethnic minorities. This changing nature of poverty reduction is combined with physical remoteness and low access to infrastructure, services, and market opportunities. There still are pockets of very remote areas with limited economic opportunities other than subsistence farming. In order to solve this "last-mile" problem of the inclusion agenda, it is important to understand the impacts of the past improvement in connectivity on the economic outcomes of individuals and households depending on their locations. By analyzing how connectivity can affect economic outcomes, the direction for future interventions can be set out.

As a growing middle-income country with a large stock of existing infrastructure assets, fostering *resilience* is a crucial foundation for Vietnam to sustain its development and well-being of the society and individuals. Vietnam has suffered significant economic losses during recent years in the form of damages to infrastructure and livelihood, and furthermore, is among the most vulnerable countries to worsening natural disasters due to climate change. Connectivity in Vietnam therefore needs to be resilient against future risks, in order to support the above two goals—

market integration and inclusive growth. Currently, considering the pace at which infrastructure is built both at national and local levels, the underlying system of assessing risks and managing the built assets is under-developed. A pathway toward resilient connectivity would require sound analysis of risks and vulnerability. Based on such analysis, the economic costs of future natural hazards and other forms of disruptions should be estimated, which will help identify how best to build resilient connectivity.

Report Outline

In addressing the above critical development goals, we organized the remainder of the report into five distinct but inter-related chapters, each analyzing central aspects in the case for "Connecting Vietnam for Growth and Shared Prosperity."

Chapter 2: Integrating with Global Markets—Analyzes the connectivity in the context of Vietnam's trade competitiveness and participation in global value chains. The chapter covers value chain-critical transport corridors, performance and efficiency of international gateways, and the relationship between economic clusters and corridor development.

Chapter 3: Integrating Domestic Markets—Analyzes connectivity for domestic consumers in the context of the emergence of urban middle-class consumers, which has given rise to demand for e-commerce and perishable foods in cities. The chapter also discusses the connectivity implications of recent trends as well as the challenges of urban logistics.

Chapter 4: Delivering on "Last-Mile"—Focuses on Inclusion, and the role of connectivity in achieving inclusiveness of economic growth in Vietnam. The chapter provides a conceptual link between connectivity and economic outcomes, measurement of connectivity in terms of market access, empirical relationships between market access on economic outcomes, and the welfare effects of transport network development.

Chapter 5: Building Resilience—Provides an in-depth analysis on the vulnerability of transport connectivity and how Vietnam can improve resilience through network analysis and prioritization techniques.

Chapter 6: Recommendations—Summarizes key recommendations based on the analyses of the previous chapters outlined above and outlines key connectivity-related policy priorities for implementation.

NOTES

1. Transloading of truck loads occurs at the border. The costs in table 1.1 represent the Vietnam leg only and exclude administration and transport costs within China.
2. AIC-RIS 2019 provides a detailed study on NTMs between ASEAN and India.
3. The network in table 1.3 represents about 90 percent of what is statistically captured in figure 1.5, due to the data gaps in geocoordinate information of some roads.
4. DWT is the normal measure of how much weight a vessel can carry and excludes the weight of the vessel itself.

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CHAPTER 2

Integrating with Global Markets

Duc Minh Pham, Jung Eun Oh, Roman Constantin Skorzus, and Charles Kunaka

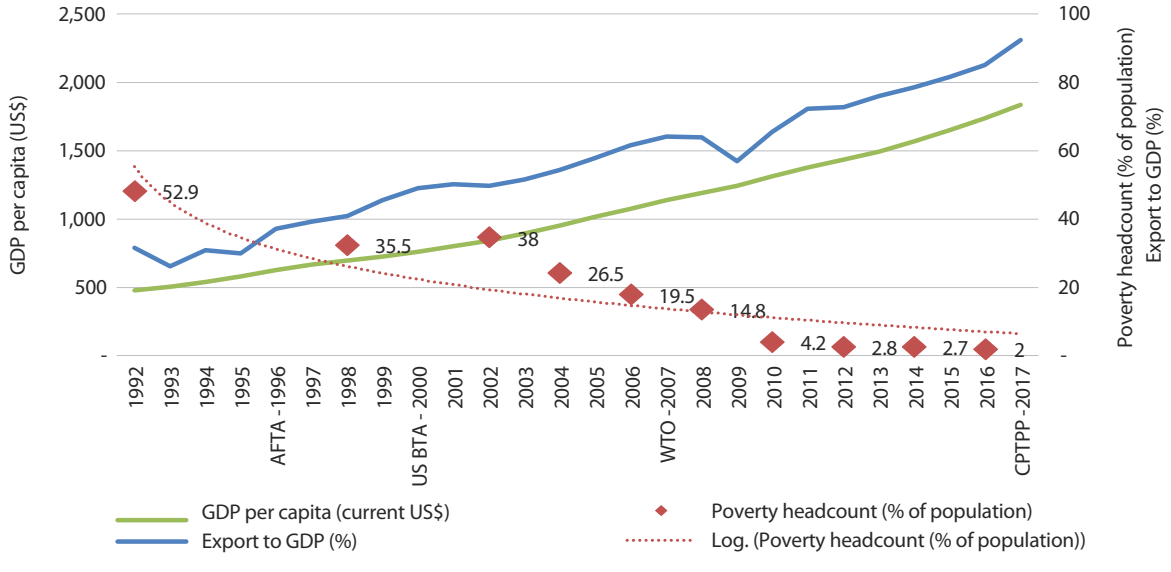
Vietnam is an active member of global value chains (GVC) and trade is a major source of its economic growth. Trade—especially export—competitiveness is largely determined by trade costs as well as costs for goods and services. Trade costs comprise tariffs, non-tariff barriers, and transport and logistics costs (TLC). As tariffs on international trade have been sharply reduced and manufacturing costs have increased, Vietnam's export competitiveness increasingly depends on factors such as quality, productivity, efficient supply chains, and lower transport and logistics costs. This chapter examines Vietnam's participation in GVCs, its spatial relationship between trade and transport, and the way in which trade and transport infrastructure can be improved to support Vietnam's trade competitiveness.

Vietnam and the Global Value Chain[1]

Global empirical evidence shows that trade promotes growth. Through increased competition, trade reallocates resources toward more productive sectors and firms and boosts real incomes by lowering prices for consumers and firms. And by supporting growth, trade openness can also be an important driver of poverty reduction. During the period between 1960 and 1990, eight high-performing Asian economies in terms of trade—Japan; Republic of Korea; Taiwan, China; Hong Kong SAR, China; Singapore; Malaysia; Indonesia; and Thailand—had an average growth rate of 5.5 percent per year, higher and more sustainable than any other groups of countries in the world (Birdsall and others 1993). Vietnam is no exception. The export-led growth strategy and global integration adopted in Vietnam have been key factors, among other things, for Vietnam's remarkable achievement over the last more than two-and-half decades in generating economic growth and poverty reduction.

During the period from 1992 to 2017, Vietnam developed into one of the world's most open trading countries, with an export-to-GDP ratio of more than 100 percent in 2017. Figure 2.1 shows the interlink between the trade (export to GDP ratio), the growth trend reflected by GDP per capita, and the poverty reduction (headcount ratio at US$3.2 per day) for the period. As an export power house, in the past ten years, Vietnam's merchandise export growth averaged more than 15 percent, almost five times the global growth. As a result of this remarkable trade performance, Vietnam's GDP per capita, measured by constant price in 2010, realized a nearly four-fold increase during this period, from less than US$500 in 1992 to more than US$1,800 in 2017. The poverty rate of Vietnam also decreased remarkably over the same timeframe—with the poverty line threshold at US$3.20 a day, the poverty headcount as a percentage of Vietnam's total population decreased from nearly 52.9 percent in 1992 to 2.2 percent in 2017.

FIGURE 2.1. **Export-Led Growth and Poverty Reduction, 1992–2017**

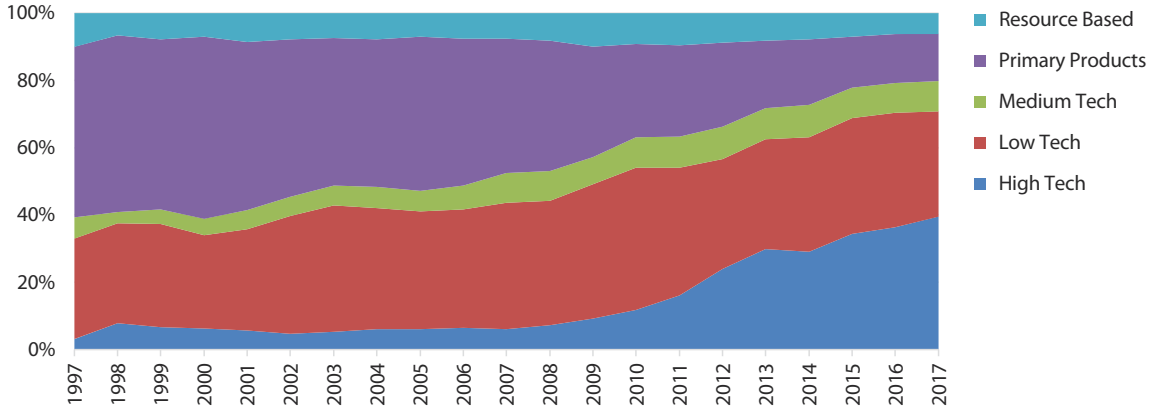


Source: UNComtrade database, available at https://comtrade.un.org/.

Vietnam's trade has grown alongside its deepening global integration and participation into global value chains. The revolution in information and communication technologies (ICT) and falling transportation and communications costs drove offshoring and unbundling of production from the developed to the developing world and gave rise to global value chains. This has implications for (a) how developing countries can participate in international trade—joining GVCs by "importing to export," and (b) how trade can be a vehicle for development—enabling knowledge dissemination along with jobs in multinational corporation (MNC) production. Since 1995, Vietnam has carved out a role for itself within GVCs, showing higher integration as a buyer and a seller in GVCs. An improved business environment for attracting qualified foreign direct investments (FDI) has promoted Vietnam's participation in a number of GVCs. Between 1995 and 2011, Vietnam grew its domestic value added—embodied in its gross export—by 16.6 percent annually, just below what had been achieved by China. By specializing in assembly functions on behalf of primarily foreign firms, Vietnam's export-oriented development strategy has created jobs, propelled economic growth, and reduced poverty.

As a result of GVC participation, Vietnam's export structure has changed dramatically, both in terms of technology embodied in export and product-based export. Figure 2.2 shows a significant structural change in technology embodied in export during the period between 1997 and 2017. The demonstration is built on UNComtrade's international classification of export technology levels, including low tech, medium tech, high tech, primary, and resource-based. The export share of low- and medium-technology, resource-based products did not change significantly during this period. However, the proportion of primary products has declined markedly, mainly due to a decline in crude oil export and export control policy to limit minerals and raw material export. At the same time, the share of high-technology products export increased sharply, a trend closely associated with huge investment projects of some leading multinationals—including Samsung Group and Intel Corporation—which selected Vietnam as a production base for mobile phone and tablet products for export worldwide. Box 2.1 takes a closer look at the role Samsung Vietnam's has played in Vietnam's emerging electronics value chain. Two mega trends that may disrupt GVCs in the future, notably the acceleration of the digital transformation, automation in particular, and emerging trade protectionism. These trends may result in re-shoring of the way Vietnam's integration into GVCs especially in the context when comparative advantage in cheap labor enjoyed by developing countries including Vietnam may be quickly eroding due to automation.

FIGURE 2.2. **Structural Change in Technology Embodied in Export, 1997–2017**



Source: UNComtrade database, available at https://comtrade.un.org/.

In sum, trade and participation in GVC is crucial to the continued success of Vietnam's economic model. In devising a connectivity strategy to continue supporting such trends, one might want to ask:

- Which specific sectors or value chains require the most attention?
- Are some value chains more dependent on transport and logistics connectivity than others?
- Which corridors will become critical as Vietnam aspires to improve its trade competitiveness?

The remainder of the chapter addresses these questions using a four-step methodology to understand the key sectors, their value chain linkages, spatial structure of the value chains, and eventually connective propensity, as illustrated in figure 2.3.

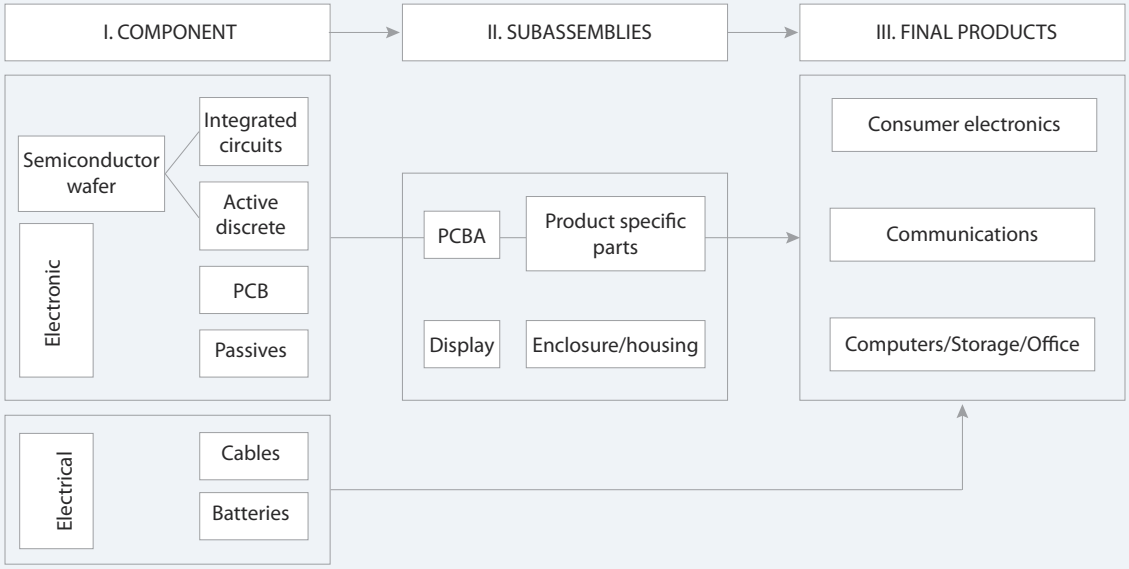
FIGURE 2.3. **Value Chain Connectivity Methodology**

Selection	• Selecting value chains of high comparative advantage and trade performance that contribute to trade growth, industrialization, and global value chain integration
Linkages	• Identifying domestic input–output linkages and operational structure of selected value chains
Spatial Structure	• Defining the spatial structure of selected value chains based on linkages, regional specialization, and gateway analysis
Connective Propensity	• Outlining the connective propensity of selected value chains based on spatial structure and linkages and quantifying supply chain-based corridors

Source: Based on Pham and others 2013.

Box 2.1. Electronics Value Chain and Samsung Vietnam

Electronic products are often categorized into three groups: computers, communications, and consumer electronics (3C). In electronic value chains, they are the final products to be assembled from a number of components and parts, such as semiconductors, integrated circuits, printed circuit boards (PCB), and so on. Electronics—especially cellphone parts—are usually small and light, and more likely to be high in unit value, and thus easily transported by air. These characteristics enable such global value chains to spread across countries and continents to optimize comparative advantages and country specialization and build supply chains around air transportation and logistics.



Samsung started their business in Vietnam in 1996 with a small joint venture named Samsung Vina, with a total investment of US$36.5 million. Samsung Vina turned into a 100 percent FDI company after Samsung bought back all shares from its partner in 2013. In 2009, Samsung made a big move with a new project in Bac Ninh producing smartphones, with the total investment of US$670 million. Since then, Samsung has been expanding production, opening six new factories in Vietnam—in Bac Ninh, Thai Nguyen, and Ho Chi Minh City provinces, along with a research and development center in Hanoi—with a total of US$17 billion in registered investment capital.

A decade after starting the first smartphone project, Samsung has cultivated its Vietnam supply chain with 29 suppliers—up from four in 2014—and is expected to expand to 50 by 2020. Although the local supply chain has expanded, Samsung still relies on imported parts delivered mostly from China through the Huu Nghi land border gate, or from other countries via Dinh Vu seaport, and most importantly from Noi Bai airport. Samsung Vietnam makes the majority of its global smartphones output in Vietnam, including its latest flagship device, exported globally via Noi Bai airport. This is one of main reasons Samsung's share of smartphone export has increased significantly over the past decade to one-fifth of Vietnam's total exports. Samsung's share of trade value via air gateways has also increased rapidly, from 15.6 percent in 2011 to 39.5 percent in 2016.

Samsung Vietnam has developed a unique supply chain and logistics system to ensure the shortest delivery time for its just-in-time production in Vietnam. Noi Bai airport maintains a separated warehouse area and customs clearance line for Samsung to ensure their imports and exports proceed smoothly. Samsung's investment has resulted in structural changes in logistics, with the rapid growth of air cargo and transportation requiring a change in corresponding connective policy and logistics investment.

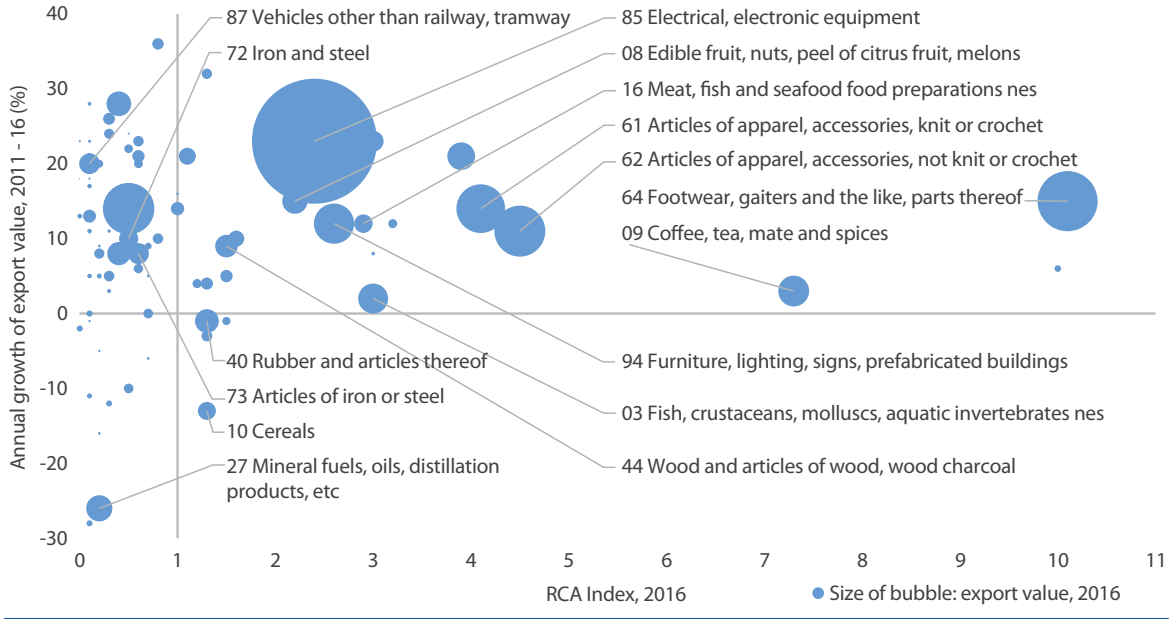
Source: World Bank forthcoming.

Value Chain Critical Transport Corridors

Vietnam's economy is more diverse than ever due to its deep integration with GVC; thus, selecting which sectors to focus on is not straightforward. In the following analysis, we selected key sectors for their (a) significant contributions to income, trade, and job creation, (b) strong comparative advantage, measured by revealed comparative advantage (RCA),[2] and (c) alignment with the government's priority. Figure 2.4 maps out all sectors based on the two-digit Vietnam Standard Industrial Classification (VSIC), according to their RCA index and annual growth rate of export value during the 2011–16 period.

The first quadrant of figure 2.4 contains the sectors in the growth trajectory and where Vietnam has comparative advantage. From these, and considering the government's priorities, we selected nine value chains—textile and garments, leather and footwear, electronics, wood products, rice, aquaculture, coffee, rubber, and vegetables and fruits—responsible collectively for more than 70 percent of total export in 2017.

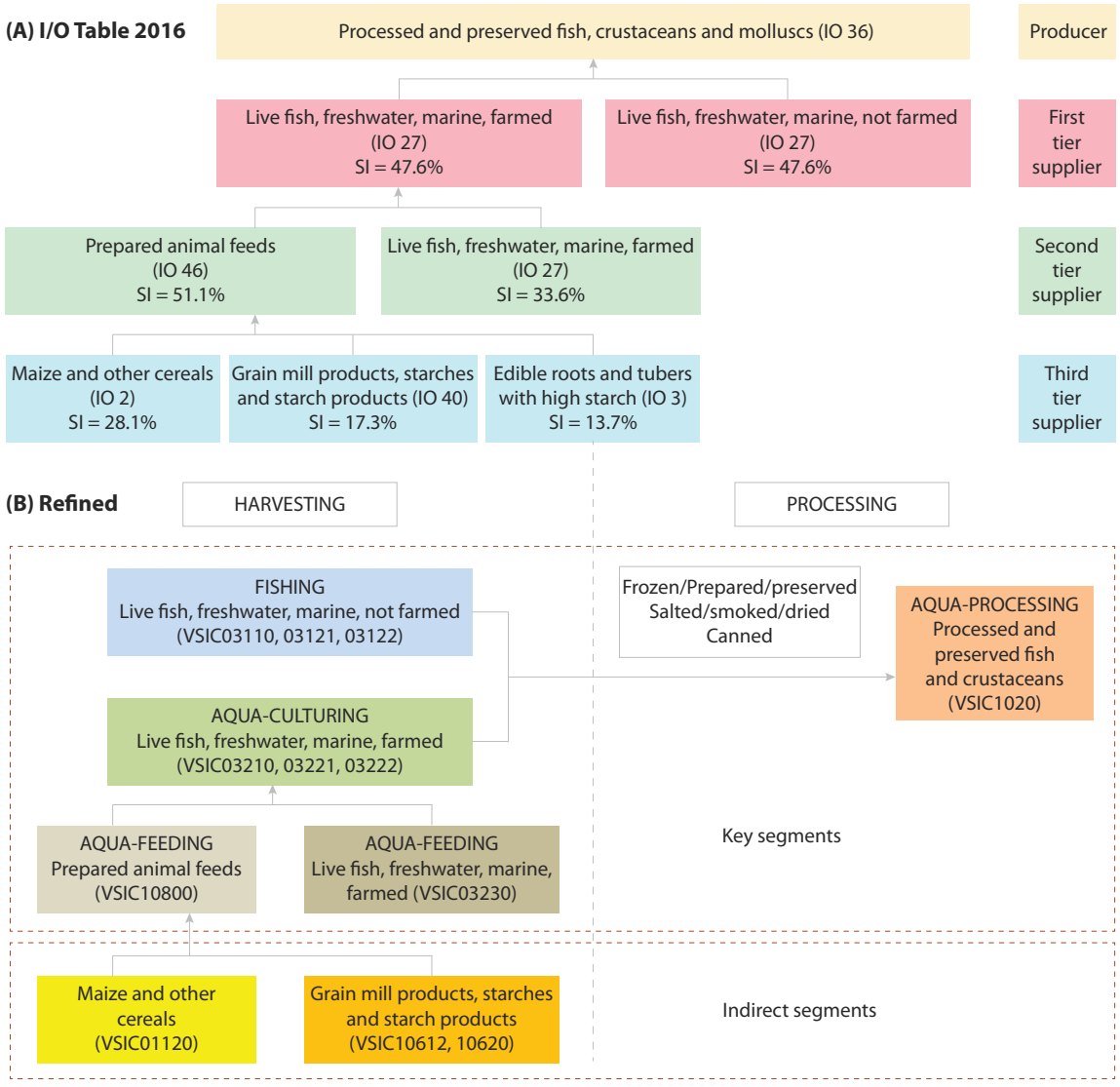
FIGURE 2.4. **Selected Value Chains Based on Comparative Advantage and Trade Performance**



Source: Generated using 2016 data from the Trade Map online database, available online at: https://www.trademap.org/Index.aspx.

Each sector can then be developed into a value chain linkages based on its domestic input–output production linkages. The study defined multi-tier supplying sectors and their backward linkages based on computed sector's sourcing intensity using data from Vietnam's input–output tables for 2011 and 2016. Figure 2.5A presents an example for aquaculture value chain linkages. Value chain linkages are then refined in combination with external information from existing value chain maps or clusters, allowing to build on the Vietnam Standard Industrial Classification codes.[3] Figure 2.5B shows refined aquaculture value chain linkages with VSIC codes of related commodities within this value chain.

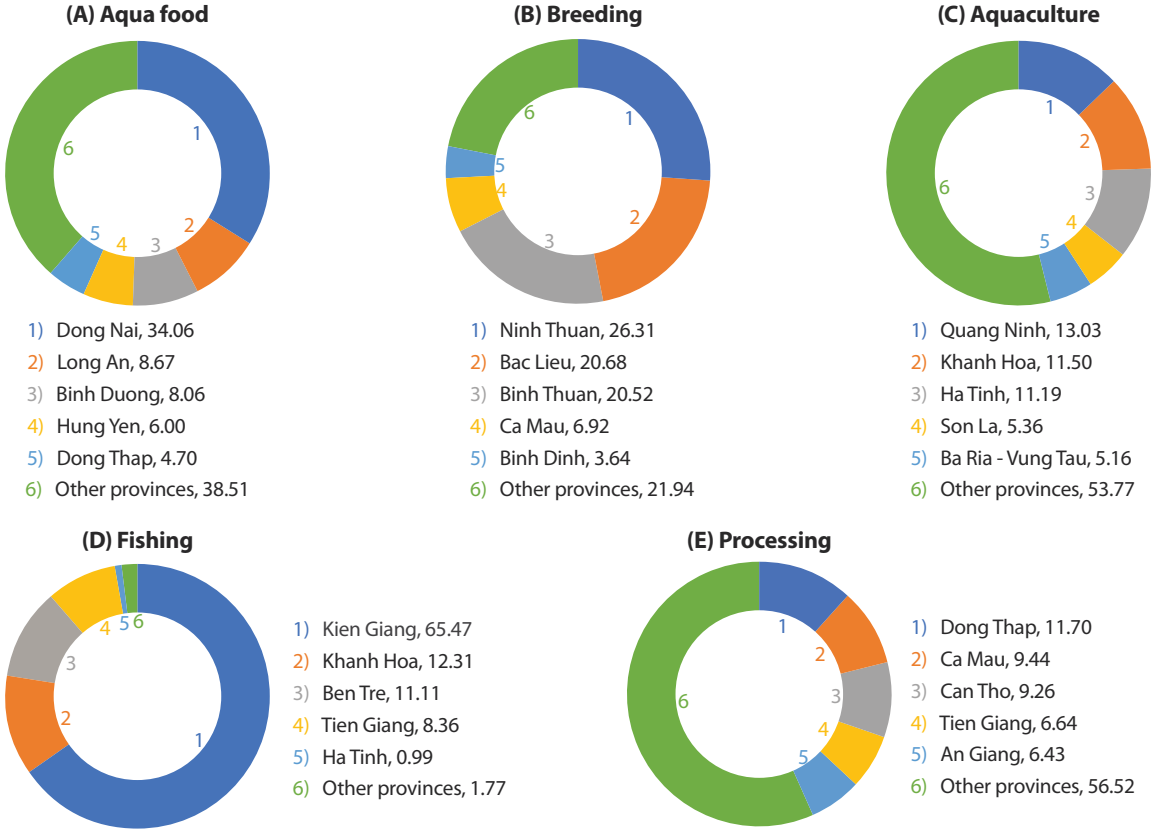
FIGURE 2.5. **Building a Value Chain for the Aquaculture Sector**



Source: World Bank forthcoming.

Once the value chain linkages have been created, the spatial structure of the value chain or its geographical distribution and industrial concentration of their backward segments is identified. This is done by quantifying the concentration of economic activities in each province measured by the level of employment found in the enterprise census conducted by GSO. As shown in figure 2.6, the makeup of the top five provinces in terms the share of total employment varies greatly across the value chain segments. In segments that rely more on primary resources, provinces with natural endowment dominate; employment is more spread across multiple provinces in segments that depend on manufacturing and services.

FIGURE 2.6. **Provinces Participating in Aquaculture Value Chain Linkages**



Source: World Bank calculations based on data provided by the General Statistics Office.

The final step is to link the value chains with the transport network, to identify parts of the "value-chain critical" network. A value chain's connective propensity is analyzed based on locational distribution of its segments and linkages, as well as its interaction with the transport network. Traffic is assumed to flow on the lowest cost paths between the key locations along each segment of a value chain, from the inputs, production and processing, and end consumers, which in the case of an export-dominant sector are located at key international gateways. Figure 2.7 presents the results of transport mapping for aquaculture.

By repeating the same analysis for all nine value chains, which combined account for more than 70 percent of total export, the export value-chain critical transport corridors are identified, as shown in figure 2.8. The thickness of a transport link represents the number of value chain linkages relying on it and highlights the parts of the network crucial to support not just movement of final export products, but also the backward input linkages connecting them. Key corridors are found (a) around the largest economic centers—Hanoi and HCMC—connecting nearby provinces that participate in the value chains, (b) between Mekong delta region and HCMC, (c) between Hanoi and northern Chinese borders, (d) along the north–south coastal line, and (e) between the central highlands and the south. Ensuring quality infrastructure and necessary logistics services along these corridors would help lower the trade and transport costs associated with these value chains, crucial for Vietnam's export competitiveness.

FIGURE 2.7. **Value-Chain Critical Transport Network: Aquaculture Value Chain**

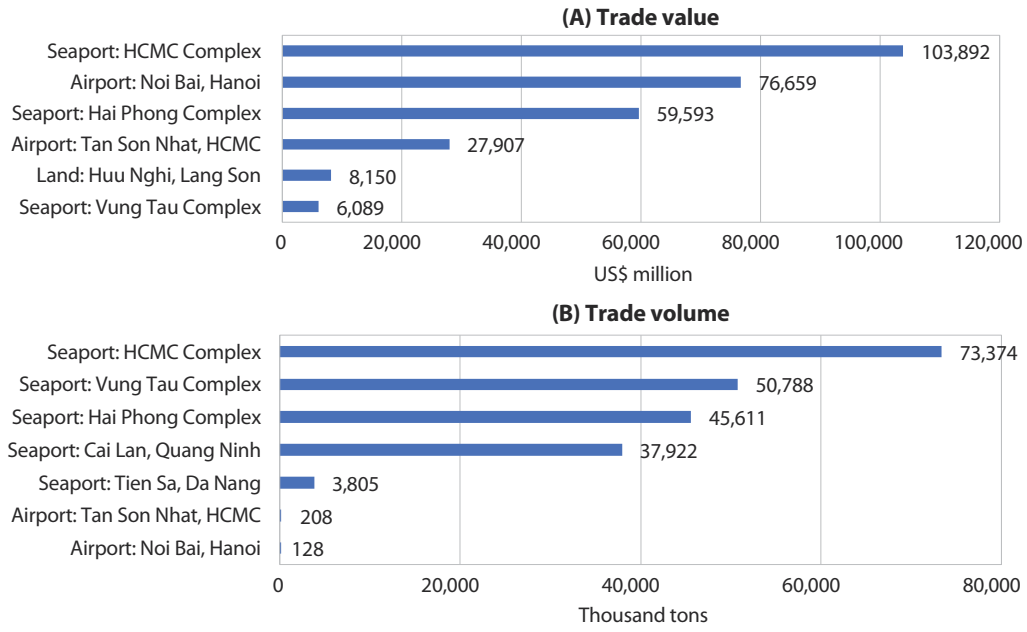
FIGURE 2.8. **Value Chain Critical Transport Network: Aggregate of the Nine Value Chains[4]**

Performance and Efficiency of International Gateways

For Vietnam's trade-intensive economy, the importance of efficiency and performance at border gates in the context of trade connectivity cannot be emphasized enough. Trade costs are highly dependent on the connectivity between border gates and the wider transport network, the efficiency of cargo handling procedures at borders as well as the interrelations and connectivity between border gates. Achieving efficiency at border gates is challenging due to the evolving nature of trade flow and volumes and involvement of multiple stakeholders in the eventual outcomes. Investments in major port infrastructure would not automatically mean an upsurge in container volumes, unless key shipping lines operating in the region are sufficiently incentivized to modify their routes. A vibrant port today can lose out in competitions and become obsolete tomorrow. Nevertheless, the recent trends and feedback from various industry stakeholders can point us to key challenges and directions for future development.

While Vietnam operates 48 border gates in 31 provinces, trade flows are concentrated in only a handful of border gates. As briefly discussed in chapter 1, the top 12 border gates, two airports, five seaports and five land border-crossing points handled more than 91 percent of total trade in value in 2016 (see figure 1.2 and figure 1.3). Furthermore, the six most significant gateways, consisting of HCMC seaport complex, Haiphong seaport complex, Vung Tau seaport complex, Lang Son (land port on the Chinese border), Noi Bai airport (Hanoi), and Tan Son Nhat airport (HCMC) accounted for 81 percent of total trade (figure 2.9). This represents a natural outcome of concentrated economic activities, FDI, and value chains around Hanoi and Ho Chi Minh City, home to Vietnam's major airports and seaports as well as the epicenter of increasing trade with China through the northern border-crossing point.

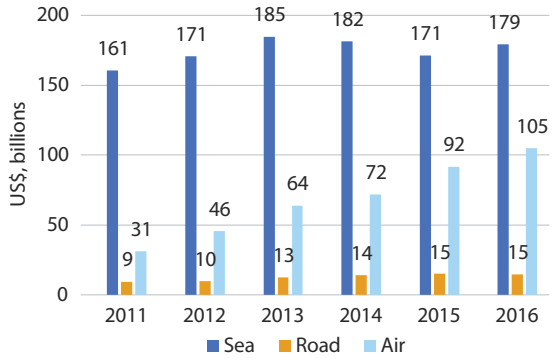
FIGURE 2.9. **Concentration of Trade in Key Gateways**



Source: World Bank estimates based on the data from Vietnam General Statistics Office, General Department of Vietnam Customs, and the Ministry of Transport.

Over the past five years, Vietnam's airports have seen remarkable growth in terms of trade value (figure 2.10). The rapid increase in flows through air gateways compared to other types of gateways coincides with a strong growth of production, export, and import of smaller volumes of higher value goods, such as mobile phones, electronic components, high fashion export, and high-value processed agricultural products. This shift is primarily due to Vietnam's deepened participation in GVC and significant influx of FDI, strategically located nearby these airports. As a result, air cargos in Vietnam are now dominated by electronics and electrical equipment—which rose from 52.3 percent of total air cargo in 2011 to 75.9 percent in 2016 (see table 2.1). A handful of FDIs are responsible for these trends and cargo composition.

FIGURE 2.10. **Value of Trade by Type of Gateway, 2011–16**



Source: World Bank calculation based on data provided by the General Department of Vietnam Customs.

The composition of exports and imports at both airports and seaports is changing, though not drastically. As presented in table 2.1 and table 2.2, between 2011 and 2016, the lists of most imported and exported products through airports and seaports remain largely unchanged except for a few products. Seaport cargo is more diverse than airport cargo, with no single category exceeding 15 percent of total value and the relative shares of specific categories fluctuating more widely.

TABLE 2.1. **Import and Export Products through Vietnam Airports**

		2011		2016
Top import products	HS85 Electronics and electrical equipment	52.3%	↑	75.9%
	HS90 Optical, photographic	6.4%	→	6.8%
	HS84 Machines and parts	9.9%	↓	6.2%
	HS30 Medicine	5.8%	↓	3.4%
	HS39 Plastic and plastic products	2.2%	→	3.1%
	HS71 Natural/cultured pearls	15.5%	↓	1.3%
	HS41 Hides and leather	1.1%	→	0.9%
	HS82 Tools, utensils, knives, scissors	(outside top 8)	→	0.6%
Top export products	HS85 Electronics and electrical equipment	52.7%	↑	76.5%
	HS84 Machines and parts	5.5%	↑	7.1%
	HS90 Optical, photographic	5.5%	→	5.2%
	HS61 Clothing and accessories, knitted or crocheted	5.2%	↓	2.3%
	HS62 Clothing and accessories, not knitted or crocheted	3.3%	↓	2.1%
	HS71 Natural/cultured pearls	17.7%	↓	1.6%
	HS64 Shoes, sandals, gaiters and parts	2.0%	↓	0.7%
	HS42 Leather products, saddles and harnesses	(outside top 8)	→	0.7%

Note: ↑ denotes an increase in share between 2011- 16; ↓ denotes a decrease; → denotes less than 1 percent point change.
Source: World Bank calculation based on data provided by the General Department of Vietnam Customs.

TABLE 2.2. **Import and Export Products through Vietnam Seaports**

		2011		2016
Top import products	HS84 Machines and parts	12.4%	↑	14.6%
	HS85 Electronics and electrical equipment	13.5%	↓	10.4%
	HS39 Plastic and plastic products	6.3%	↑	8.8%
	HS72 Iron and steel	7.2%	→	6.2%
	HS87 Vehicles	2.3%	↑	3.9%
	HS60 Types of hosiery of crochet	(outside top 10)	↑	3.4%
	HS52 Cotton	2.6%	→	3.1%
	HS55 Artificial staple fiber	2.2%	→	2.7%
	HS27 Mineral fuels and oils	11.8%	↓	2.6%
	HS23 Residues from food industry	2.1%	→	2.5%
Top export products	HS85 Electronics and electrical equipment	13.4%	→	12.7%
	HS62 Clothing and accessories, not knitted or crocheted	7.2%	↑	9.5%
	HS64 Shoes, sandals, gaiters and parts	7.0%	↑	8.5%
	HS61 Clothing and clothing accessories	6.2%	↑	8.4%
	HS84 Machines and parts	4.4%	↑	5.9%
	HS94 Furniture, bedding, cushions	(outside top 10)	↑	5.3%
	HS03 Fish and other crustaceans	5.1%	→	5.2%
	HS09 Coffee and tea	3.9%	→	3.8%
	HS39 Plastic and plastic products	(outside top 10)	↑	2.6%
	HS08 Nuts and citrus fruits	(outside top 10)	↑	2.5%

Note: ↑ denotes an increase in share between 2011-16; ↓ denotes a decrease; → denotes less than 1 percent point change.
Source: World Bank calculation based on data provided by the General Department of Vietnam Customs.

Key gateways face three-pronged challenges: capacity constraints at major gateways, connectivity constraints to the transport network, and demand-supply mismatch. Each is explored in detail below.

The rapid increase in cargo handled through major airports—at 10.8 percent per year during 2009–17 (in terms of value)—poses an increasing pressure on airport capacity, with respect to their runways, terminals, and affiliated logistics facilities. Industry stakeholders, including the logistics service sector, shippers, and cargo owners often raise their concerns of aggravating congestion at Vietnam's airports, especially at Tan Son Nhat airport in HCMC. In fact, the Government of Vietnam has long recognized this issue and has allocated significant funding for capacity expansion and efficiency improvements in major airports as well as construction of new airports, notably the planned development of Long Thanh airport in an eastern suburb of HCMC. Given the time-sensitivity involved with handling high-value air cargos, sufficient capacity—both physical and operational—would be essential to meet the growing demand resulting from the Vietnam's evolving global value chains.

Hinterland connectivity around major gateways, particularly road connections to and from major ports, is also limited. Assessment of travel speed data from various sources, including from the commercial vehicle tracking system (CVTS) data provided by the Directorate for Roads of Vietnam

(DRVN), shows the impacts of traffic congestion in the transport network around major gateways (see the section titled "Challenges and Opportunities for Logistics Services" in chapter 3 for further details). Congestion is particularly severe around HCMC's Tan Son Nhat airport and the HCMC seaport complex (including Cat Lai port), the two major facilities located closest to high-density urban areas. On the major connecting roads around these facilities, heavy truck traffic and urban commuter traffic mix, posing a significant urban mobility challenge. To mitigate congestion, local governments sometimes resort to regulatory measures such as truck traffic bans. Given the conflicting interests between heavy truck traffic and urban commuters, such measures do not offer a sustainable solution. A more comprehensive congestion mitigating solution could include development of various logistics facilities such as urban distribution centers, warehousing, and development of public transport systems for commuters currently relying on private transport modes.

Similar challenges apply to intermodal connectivity around Vietnam's inland waterway transport, which forms an integral part of trade corridors. Many of Vietnam's river ports and terminals along Vietnam's extensive inland navigation system are poorly connected to the main road or rail network. Moreover, many seaports lack capacity to efficiently handle transshipment to and from inland waterway vessels, creating capacity bottlenecks and increasing transport costs. For instance, some ports in Vung Tau seaport complex were built with limited berth capacity for handling IWT vessels, as at the time, planners anticipated that most traffic would come through land via the road network. When the ports started operation in 2011, however—partly due to the delayed construction of the connecting roads and partly to the lower transport costs on IWT compared to roads—much more cargo arrived by barges than by trucks. This created unexpected, yet serious capacity chokepoints for container cargo handling, which were later relieved through construction of additional port berths for IWT vessels.[5]

Obvious imbalance exists between demand and supply at Vietnam's various seaports. Operating at or near capacity, the two historically important seaports—HCMC seaport complex and Haiphong seaport complex—continue to handle most of Vietnam's trade volume. Meanwhile, the newer development in Vung Tau seaport complex is operating much below the designed capacity; some of the container terminals, especially those in the inner coast where the water is shallower, carry containers at as little as 30 percent of capacity.[6] Terminal operators attribute this underutilization primarily to (a) poor land connectivity between ports and main industrial production sites around HCMC, (b) lack of ancillary logistics facilities such as inland container depots (ICD) near these newer ports, and (c) strong inertia of port clients (shippers, importers, exporters, and forwarders) accustomed to the procedures at HCMC seaport complex. Nevertheless, signs point to these deep-sea ports gaining competitiveness through their natural advantages (for example, water depth) and continued efforts to improve service and lower prices, as shown in table 2.3. Container volume handled at the Vung Tau seaport complex is increasing more rapidly than that of HCMC seaport complex or the average of all other Vietnam seaports.

TABLE 2.3. **Trends in Throughputs in Vietnam's Seaports**

Throughput (excluding IWT barge volume)	2017, 12 months (million TEU)	2018, first 10 months (million TEU)	2018 10 mo./ 2017 10 mo.
Vietnam's ports total	12.21	10.74	6.1%
HCMC Seaport Complex and Vung Tau Seaport Complex	8.67	7.78	9.5%
Vung Tau Seaport Complex	2.44	2.40	21.0%

Source: Vietnam Seaports Association (VPA), presented during a November 2018 meeting between World Bank and Cai Mep International Terminal (CMTI). Data through October 2018. VPA website: http://www.vpa.org.vn.

The new deep-sea port in Lach Huyen, off the coast of Haiphong near the existing Haiphong seaport complex, started operating one of its several planned terminals in 2018. Lach Huyen port is expected to exhibit similar characteristics as Vung Tau seaport complex, in terms of its capacity to handle large vessels and its relationship with its more inner-city counterpart, Haiphong seaport complex. Uncertainty remains, however, around how many of the exiting terminals at Haiphong seaport complex would eventually move to Lach Huyen when construction of the additional terminals is completed.

Given these dynamics, in addressing the demand-supply mismatch, Vietnam's gateway strategy should be driven by a *network perspective,* not by the perspective of individual ports and airports. While the seaports currently dominating the market have demonstrated they can provide highly efficient services to their customers (as seen by the strong market inertia), they also have limited room to expand capacity. Moreover, Vietnam could potentially realize a significant gain by having a vibrant transshipment facility able to call large vessels with intercontinental capacity. With increasing trade and container volumes, direct intercontinental shipment could significantly reduce transit time. For instance, the transit time from the Haiphong International Container Terminal at Lach Huyen—if ships go through transshipment ports such as Hong Kong SAR, China or Singapore—would be 32 to 35 days to the east coast of the United States, and 28 to 30 days to Europe. Calling an intercontinental mother ship into Lach Huyen would reduce the transit time by around five days, to approximately 27 to 30 days to the east coast of the United States, and 23 to 25 days to Europe.[7] Currently, every week the Vung Tau seaport complex operates around 13 direct services to the United States and two to Europe. Industry stakeholders predict that with continued good services and connectivity, these ports have the potential to further increase operations.

A shift toward deep-sea, international transshipment facilities would go hand-in-hand with cargo consolidation for export and import, which may require redefining the roles of Vietnam's smaller ports to focus more on domestic coastal shipping to and from these international terminals. Such an arrangement, resembling a "hub-and-spoke" structure, would mean a need to further develop domestic shipping routes, to provide a more vibrant role to smaller ports in moving cargos by sea to key coastal cities in Vietnam, rather than by roads. This would also require improving hinterland connectivity for these smaller ports via roads, railways, and inland waterways, to reduce transport costs associated with intermodal connections.

Economic Clusters and Corridor Development

Ample empirical evidence suggests that agglomeration and clustering in space enhances productivity and economic efficiency. The spatial economy of Vietnam has major concentrations of economic activity in its two economic centers, Hanoi and Ho Chi Minh City, which collectively account for more than 60 percent of the country's gross domestic product. Industrial parks, the most prevalent instrument for manufacturing and industrial growth in Vietnam,[8] are also concentrated around these two cities. This section seeks to understand how economic clustering relates to trade and transport connectivity and how Vietnam can reap the benefits of agglomeration for its future trade competitiveness. Particularly, we explore the relationship between the placement of industrial parks and the following four elements of connectivity: (a) to transport corridors, (b) to labor markets (urban centers), (c) to other industrial clusters, and (d) to international gateways. In order to obtain granular insights, we based the analysis on zones located in the northern part of Vietnam, and especially in the Red River Delta.

Industrial and processing zones, also known as *industrial parks,* specialize in manufacturing of industrial products and supporting services. Occupying defined geographical areas, the total number of industrial parks (IPs) has increased from 264 in 2010, with 75 percent in operation, to 376 in 2018, with around 86 percent operational (table 2.4). In total, some 499 industrial parks have been designated in nearly all provinces, though they are unevenly distributed. Among these parks, only a few high-tech enterprises have been established to support scientific and technology research and training. In addition, two main types of economic zones—those near the land borders, border-gate economic zones, and coastal economic zones—have been established with the intent to stimulate economic activity by exploiting nearby harbors.

TABLE 2.4. **Selected Statistics on Vietnam's Industrial Parks, 2018**

Indicator	Foreign Invested	Domestic Invested	Total
Number of IPs	57	319	376
Number of IPs currently operational	43	282	325
Number of projects (enterprises)	7,745	6,992	14,737
Amount of registered capital (million US$)	123,478	795,582	919,060
Amount of disbursed capital (million US$)	82,284	376,528	458,812
Number of Employees	691,221	2,511,821	3,203,042

Source: World Bank estimates based on data provided via email by the Ministry of Planning and Investment in November 2018.

In the analysis below, we focused on the industrial parks in the northern part of the country, situated around Hanoi and along some major transport corridors, as depicted in figure 2.11. The majority of the IPs are concentrated around the national highway no. 5 (NH5) corridor, which had existed when the first IPs started to locate in the early 1990s. These industrial parks have collectively attracted significant amounts of both foreign and domestic investments, totaling over US$43 billion as of 2018, shown in figure 2.12.

FIGURE 2.11. **Location of Industrial Parks vis-à-vis the Main Transport Corridor in Northern Vietnam**

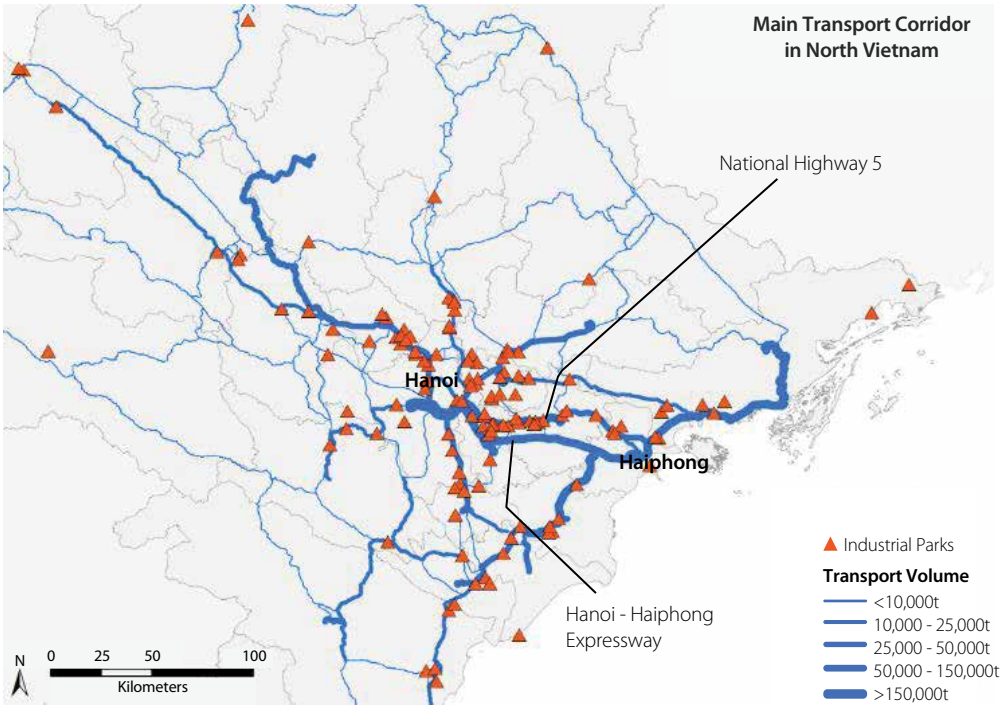
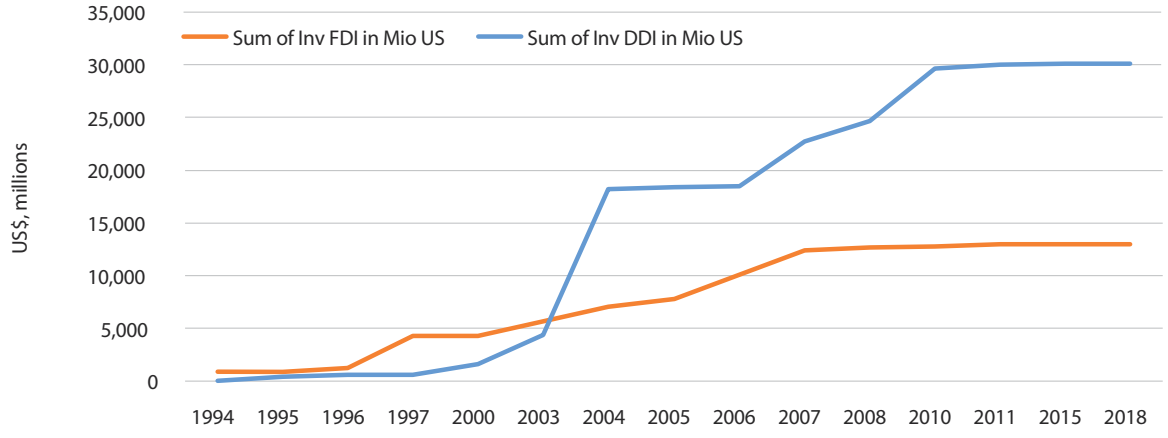


FIGURE 2.12. **Concentration of Trade in Key Gateways**



In a curious development that followed, investments into IP development along the NH5 corridor started levelling off around 2009, coinciding with the construction start of the parallel Hanoi–Haiphong Expressway, a fully access controlled toll road, with design speed exceeding 110 km per hour. While no concrete data is available to test the causes, increasing congestion along the NH5 necessitated the planning and construction of the expressway—which since launching in 2015 has reduced the travel time between the two cities by about two hours. Perhaps not coincidentally, rising congestion and the halt in further investments into new IPs along this corridor share a common cause for agglomeration reaching a saturation point, thereby prohibiting any additional development.

The below provides IP characteristics in the northern part of the country. As expected, industrial parks are located in proximity to major transport corridors; however, due to the endogeneity, it is impossible to establish the causal relationship between them. As shown in figure 2.13, over 50 percent of the industrial parks are located within one kilometer (line of sight) from the nearest transport corridor and almost 80 percent are located within two kilometers. Over time these industrial parks have attracted significant investments into their operation, first driven by foreign investors, but later (from 2003 on) more strongly by domestic investors, as depicted in figure 2.14.

Industrial parks are closely located with one another, suggesting gains stemming from agglomeration.[9] The distance to other industrial parks has consistently decreased over time as new parks were built in proximity to existing parks. Figure 2.14 shows the average and minimum distances of industrial parks established within a five-year period to all earlier-established parks. Clearly, the proximity has decreased sharply, from 126 km in 1995 (with only two operational IZs) to around 1 km in 2009, with more than 58 operational parks. A decreasing distance to established parks indicates the spatial density of parks between Hanoi and Hai Phong is increasing and confirms the assumption industrial parks tend to cluster, to benefit from existing infrastructure.

FIGURE 2.13. **Distance from Industrial Parks to Main Transport Corridor**

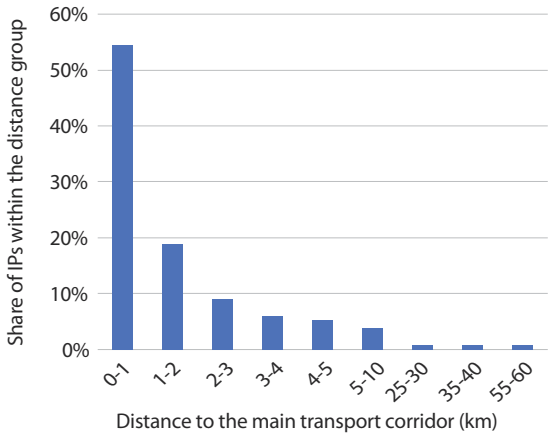
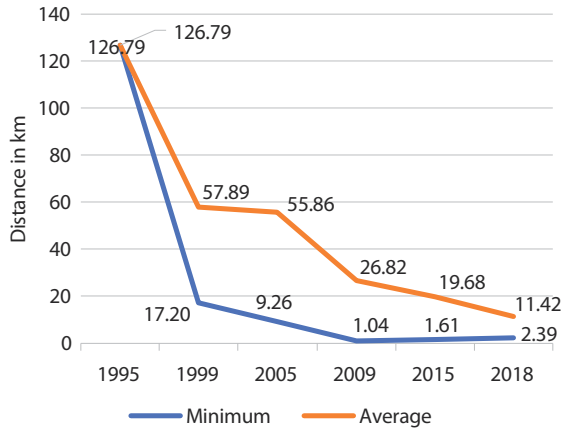
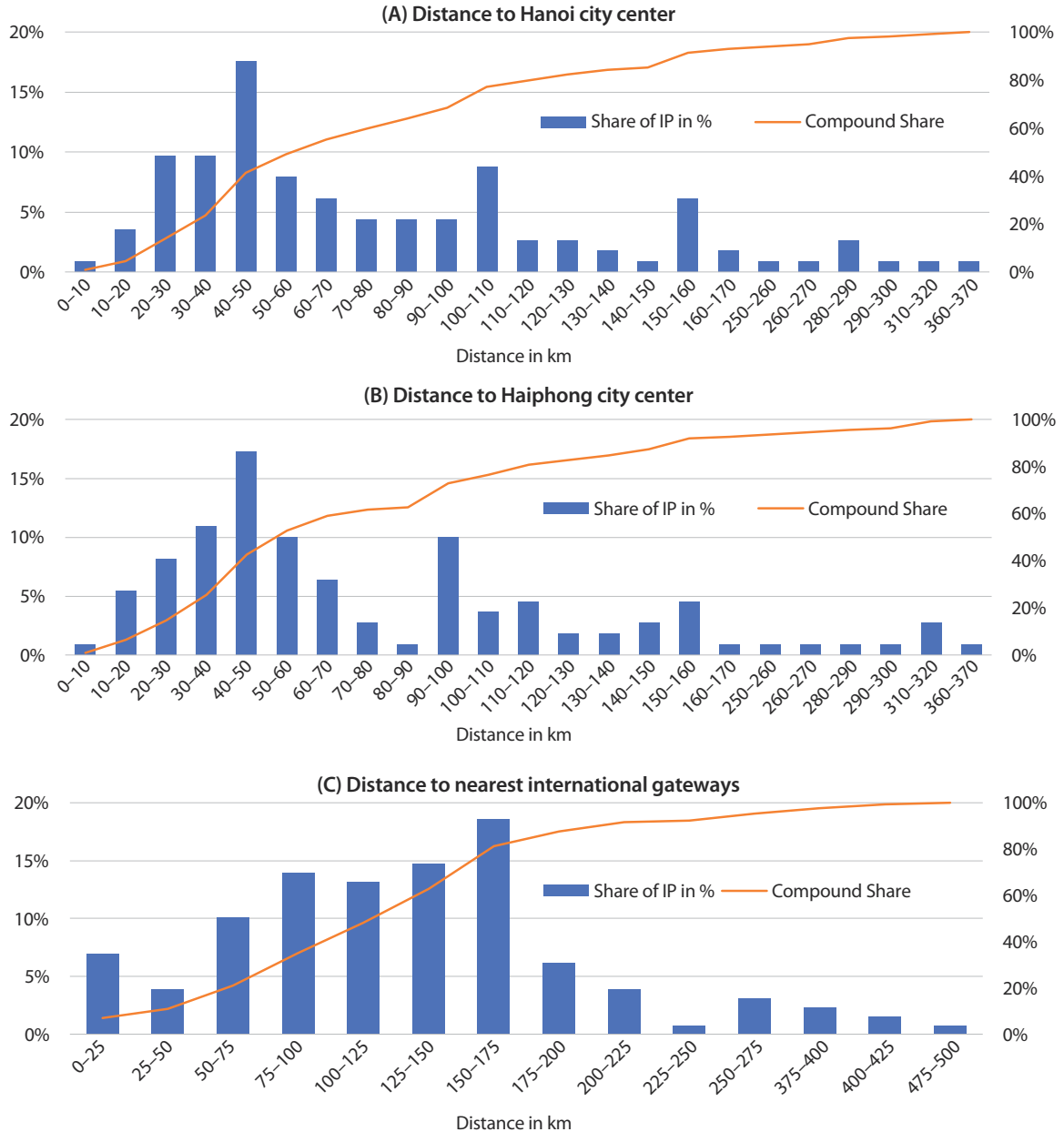


FIGURE 2.14. **Distance of Industrial Parks to Existing Industrial Parks, Five-Year Moving Average**



Furthermore, industrial parks tend to locate near urban areas that provide a skilled labor pool and a well-developed infrastructure, and act as a market for products from industrial zones (figure 2.15). Most of the industrial parks are located near Hanoi or Haiphong, two of the big urban centers in northern Vietnam. Cities also offer access to research and development networks and other forms of knowledge sharing that can benefit the industrial parks. However, industrial parks are not necessarily located as closely to the nearest ports or airports as they are to transport corridors and cities; in fact, most IPs are located approximately 150 to 175 km from Haiphong port. This suggests that longer distances to port could be compensated by connectivity to labor supply and various inputs, access to other infrastructures, and generally good connectivity to more distant locations.

FIGURE 2.15. **Distance of Industrial Parks to Various Locations**



Moreover, land-based border crossing points to neighboring countries seem not to attract conventional industrial parks, with most IPs located relatively far from border points. However, after Vietnam created dedicated border economic zones near the border-crossing points, firms that specifically benefit from the proximity to border-crossing points have moved operations to these specialized industrial zones. These patterns reflect the influence of other variables, including the availability and price of land as well as the location decisions of individual provinces.

The analysis shows no direct correlation between the size of industrial parks and their locations. In addition, parks are neither larger or smaller if closer to cities, gateways, or the corridor. Industrial park employment is also not affected by the location to urban centers or the proximity to other industrial parks. Subject to provincial planning processes and land availability, industrial park size is likely influenced by factors outside this analysis.

Lastly, the importance of regional connectivity to trading gateways is expected to grow with Vietnam integrating in large trading networks such as the Belt and Road Initiative. The seaport complex of Hai Phong, part of the maritime silk route system, will play a major role, which might increase the importance of Haiphong and Hanoi as well as the industrial parks catering to export-oriented businesses.

Based on the above known characteristics of IPs and the agglomeration history of IPs along the NH5 corridor, **we hypothesize that investments in major interurban corridors provide new opportunity for economic clustering.** This hypothesis is founded on the understanding that economic distance—not physical distance—determines a location's investment worthiness for economic clustering. Before the expressways were built, Vietnam's national highway system provided interrupted connections (that is, connections intersecting with local roads at grade) through urban areas. Even without factoring in congestion, the average travel speed hovered around 30 km per hour, and even lower for heavy duty vehicles. The slow travel speed increased the need for businesses to locate as closely to NH5 as possible, to shorten the economic distance to the major port and urban areas. However, development of expressways or other comparable major interurban connectivity infrastructure changes this equation. Now, with this infrastructure shortening the economic distance between points, firms can locate around a major junction well-connected with many useful locations. In other words, *improved connectivity enlarges the potential land areas that might be considered suitable for economic clustering*. See box 2.2 for an example of successful air and road hub connectivity in Memphis, Tennessee.

Due to a lack of integration between the process for developing economic clusters and that for developing transport, such consideration is not yet formally reflected in the existing planning and investment mechanisms in Vietnam, primarily due to the surrounding institutional structure. After the national government sets the target number of parks to develop, provinces screen, appraise, select, and implement their own industrial parks, providing supportive local infrastructure such as electricity and water supply. Yet, the nationally important interurban transport infrastructure conceived and delivered by the Ministry of Transport is not always informed by comprehensive province-level planning information regarding economic clustering. Conversely, the construction of high-speed, high-capacity corridors creates new well-connected transport nodes; however, land use surrounding these high-value nodes for economic clustering, logistics services, or other purposes that maximize the connectivity benefits requires adequate support by land-use plan and policy to encourage such investments, which in turn requires coordination across the national and local authorities.

Box 2.2. Memphis: Example of an Air and Road Hub Connectivity

The largest cargo airport in the world, located in the U.S. city of Memphis, Tennessee, handled 3.7 million metric tons of cargo in 2009, largely due to the FedEx operations there (Transport Topics 2010). Over time, the FedEx air services have attracted many other companies who compete based on time-sensitive logistics. As a result, aviation-intensive businesses are now concentrated around the airport, creating a new urban form including, "shopping malls, office buildings, hotels, hospitals, an international business center, conference and exhibition spaces, warehouses, and even a residential community" (Mihm 2006). The Memphis airport supports more than 220,000 jobs, representing more than one-third of the area's total employment.

An important trucking hub where interstate highways I-40 and I-55 intersect and I-69 (the "NAFTA Highway") also goes through, Memphis offers much more than its air operations. All major U.S. truck lines operate major terminals in the Memphis area—home to 400 trucking companies—making it possible to ship goods from Memphis by truck to 152 U.S. markets overnight, reaching most of the U.S. population with second-day service. Memphis is also an important railway hub: The Canadian National connects Memphis with the Gulf Coast, Chicago, and all of Canada. The Burlington Northern Santa Fe and the Union Pacific connect Memphis with many large cities west of the Mississippi, including the major Pacific ports, while CSX and the Norfolk Southern connect Memphis to most of the Midwest and East Coast cities and ports, as shown in the interactive graphics page put up by the Intermodal Freight Transportation Institute at the University of Memphis.[10] Finally, Memphis is the fifth largest inland port in the U.S. and the second largest port on the Mississippi River, handling more than 12 million tons annually (Schachter 2018). These varied transportation and logistics options became an important factor in attracting heavy industry to Memphis, such as the Nucor steel plant, which opened in 2008.

Source: Sheffi 2012; Lynch 2013.

CHAPTER SUMMARY

- One of the most open economies in the world, Vietnam has a very high trade-to-GDP ratio and is an increasingly active participant in global value chains. These trends have been strongly and positively correlated with both economic growth and poverty reduction in Vietnam.
- Vietnam holds comparative advantages over export in several sectors—textile and garments, leather and footwear, electronics, wood products, rice, aquaculture, coffee, rubber, and vegetables and fruits—which collectively account for over 70 percent of Vietnam's total exports.
- Value chains in the nine sectors—with backward linkages from inputs, production, and main export gateways—have been constructed. In addition, transport links along which the value chains are moved have been identified using input–output tables and various other statistics.
- These value chains and transport links have helped create a map of "value-chain critical" transport corridors, on which trade competitiveness of the nine sectors would depend.
- Vietnam's international trade is predominantly handled at a handful of key airports, seaports, and border-crossing points. With the rapid increase in air cargos, many stakeholders are growing increasingly concerned with the airports' physical and operational capacities.
- Two historically dominant seaports—in Ho Chi Minh City and Haiphong—currently operate at near capacity, with connecting roads plagued with burgeoning congestion.
- At the same time, the relatively new deep-sea ports in Vung Tau seaport complex and Lach Huyen present opportunities to further consolidate cargo and attract large intercontinental vessels, thus lowering transport costs and transit time. Success of these ports hinges on investments in hinterland connectivity.
- Economic clusters in Vietnam, in the form of industrial parks or economic zones, have been developed around main corridors, near primary international gateways, or around major urban areas. Their success, measured in terms of investments attracted and employment generated, is affected by connectivity and several other factors.
- As Vietnam develops major high-capacity, high-speed transport networks, such as the North–South Expressway, and thereby shortens economic distances across the country, broader areas become potential candidates for future economic clusters. At the same time, the areas with already developed clusters might be too congested or too expensive to attract new investment.
- Future investments in major connective infrastructure should therefore closely coordinate with land-use plans to encourage development of surrounding high-value transport nodes for high productivity activities.
- In particular, industrial parks and special economic zones require a comprehensive infrastructure planning since they act as nuclei for future clusters and urban growth. A sound infrastructure environment is crucial to reducing congesting and thus attracting more investments.

NOTES

1. This section is based on the forthcoming World Bank background paper, "Vietnam: Connecting Value Chain for Trade Competitiveness," expected 2019.

2. RCA is calculated as the ratio of the product's export share in a country relative to the product's global export share. For an RCA>1 (RCA<1 respectively), the country has a comparative advantage (disadvantage respectively) in exporting the product.

3. VSIC is crucial to ensure accurate reference and reliable source of analytical data. This study uses the five-digit VSIC 2018 which is developed by GSO based on four-digit International Standard Industrial Classification (UN Statistics Division 2008).

4. Maps for other value chains are presented in *appendix B*.

5. From a November 2018 meeting between World Bank and Cai Mep International Terminal.

6. From a November 2018 meeting between World Bank and Hutchison Ports SITV.

7. Information provided by Haiphong International Container Terminal.

8. The four main zone types in Vietnam include: industrial parks, industrial and processing zones, high tech zones, and industrial clusters. From a connectivity demand perspective, the exact definitions of zones or clusters are important as they are pertinent to physical flows of the generated goods and materials.

9. The actual benefits of agglomeration would depend on how firms locating in industrial zones form effective value chain clusters. Otherwise, firms located in industrial parks cannot take full advantage of physical proximity.

10. See the online interactive rail map for North America, launched in 2010 by the Intermodal Freight Transportation Institute (IFTI) at the University of Memphis: http://umdrive.memphis.edu/haklim/public/final_the3rd.swf.

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CHAPTER 3

Integrating Domestic Markets

Jung Eun Oh, Steven M. Jaffee, Brian G. Mtonya, and Yin Yin Lam

The Vietnamese population is growing richer and more urban. The "consumer class," which consumes US$5.50 or more per person per day, is rapidly expanding from about 49 percent in 2010 to over 70 percent in 2016. About 89 percent of urban dwellers belong to the consumer class, compared to around 66 percent of the rural population. This emerging group consumes more, and more diverse, traded goods and services than its poorer counterparts. Such changes in consumption patterns, caused by a sharp rise of incomes, mean changes in what is moved where, how, and at what costs. This chapter identifies the key drivers shaping the present and future connectivity needs of emerging consumers and discusses how such needs can be addressed to better integrate domestic markets in Vietnam.

Rising Urban Middle-Class Consumers of Vietnam

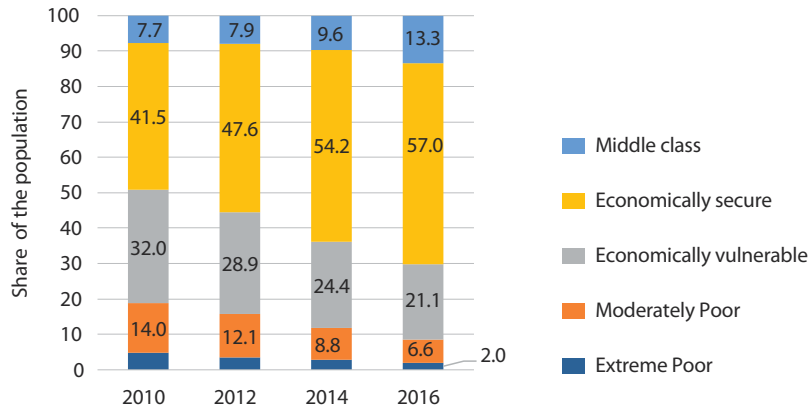
Following international norms,[1] Vietnamese households are grouped into five economic classes based on their daily consumption per capita in 2011 purchasing power parity (PPP) dollars:

- the extremely poor, who live on less than US$1.90 per day
- the moderately poor, whose per capita consumption ranges from US$1.90 to US$3.20 per day
- the economically vulnerable, who consume US$3.20 to US$5.50 per person per day
- the economically secure, consuming US$5.50 to US$15 per person per day, and
- the global middle class, who live on more than US$15 per person per day.

Households in the last two groups are referred to as the "consumer class," as they have enough income to cover daily expenses, absorb income shocks, and consume some amount of non-necessity goods and services.

Vietnam's consumer class is growing rapidly. The share of households classified as economically secure increased from less than 50 percent in 2010 to 70 percent in 2016. These include the 13.3 percent of households in the global middle class (figure 3.1), up from 7.7 percent in 2010. Most of that increase occurred between 2014 and 2016, when 3 million people joined the global middle class. Geographically, they concentrate in urban areas, where close to 89 percent of the population are economically secure, with 29 percent in the middle class. The Southeast region leads the way in economic security (91 percent), while the Midlands and Northern Mountainous regions fall short (just 44 percent), as shown in table 3.1.

FIGURE 3.1. **Population by Economic Class from 2010 to 2016**



Source: World Bank 2019.

TABLE 3.1. **Economic Class by Household Locations in 2016**

Household locations		Share of economic class in each location (%)	
		Economically secure or middle class	Middle class
Rural/ urban	Rural	65.7	7.5
	Urban	**88.7**	**29.3**
Sub-regions	Midlands and Northern Mountains	43.6	6.5
	Central Highlands	58.2	8.5
	Northern and Coastal Central	70.8	10.5
	Mekong Delta	75.4	9.6
	Red River Delta (incl. Hanoi)	**81.8**	**18.7**
	Southeast (incl. Ho Chi Minh City)	**91.0**	**28.2**

Source: World Bank 2019.

Richer consumers and their changing consumption patterns are affecting connectivity needs in Vietnam, particularly in urban and peri-urban areas. Beyond the physical connectedness, the changing patterns mean greater demand for sophisticated transport and logistics services, such as traceability, safety, timeliness, and quality. Two defining trends that lead to new connectivity challenges—changing food consumption and emergence of e-commerce—are also interrelated.

Income growth and demographic changes have resulted in major shifts in dietary and food expenditure patterns.[2] According to the Vietnam Household Living Standards Survey (VHLSS), among Vietnam's urban population, the share of food expenditure for rice has fallen from 25 percent in 2002 to less than 10 percent in 2016. For this population, animal products (meat, eggs, and fish) now account for the largest share of food expenditure—reaching over 38 percent in 2016. These shifts have not been limited to the middle- or upper-income segments of the urban population. In 2002, Q1 households spent 48 percent of their food budgets on rice versus 27 percent for meat and fish. By 2016, rice accounted for only 14 percent of their food spending, while meat and fish accounted for 39 percent.

The above trends are supported by a survey conducted by University of Adelaide in 2016–17 of 2,000 urban households in Hanoi, Ho Chi Minh City (HCMC), and two provincial cities. These survey results, depicted in figure 3.2, show even higher share of meat (and eggs) in the provincial cities than in the large national cities. As shown below, more than 60 percent of food expenditures are for fresh perishable foods across all income groups in HCMC and Hanoi and is probably closer to 70 percent once the composition of foods consumed away from home is taken into account. As incomes rise, food expenditures per person see an absolute increase due to what is commonly referred to as "dietary upgrading," which in Vietnam involves shifts to higher quality rice varieties and better cuts of meat, as well as somewhat increased spending on dairy products, beverages, and out-of-home eating.

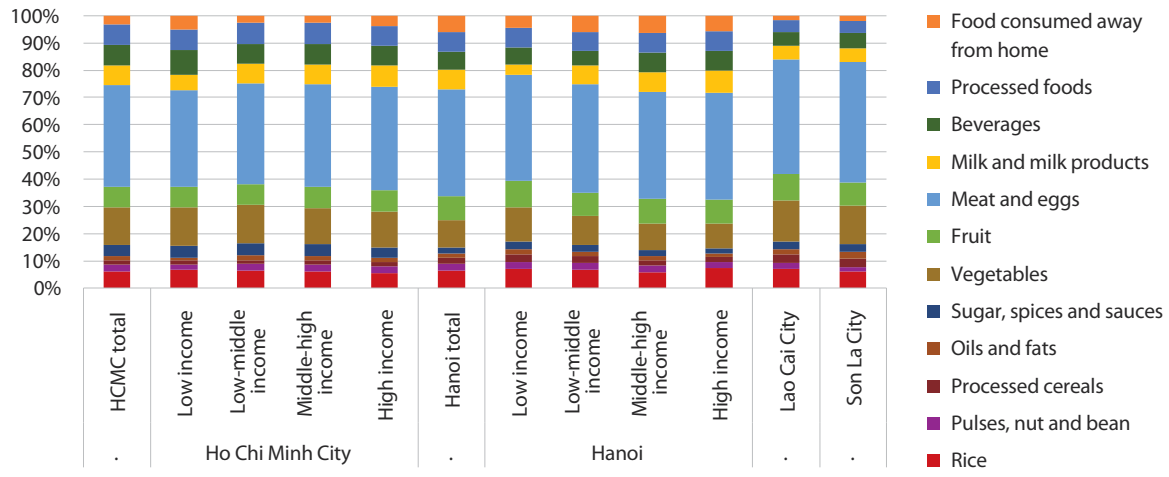
The increasingly richer and urban consumers in Vietnam also enjoy good digital connectivity, with about 82 percent of the population having access to mobile broadband. These consumers are rapidly becoming e-commerce customers, led by the following sectors: food

products (14 percent), electronics (13 percent), clothing and footwear (11 percent), machinery (9 percent), and furniture, wood, and household products (6 percent). Later in the chapter, we examine these increasing e-commerce demands by this consumer class and their implication on connectivity.

Challenges and Opportunities around Perishable Foods for the Cities

After successfully overcoming food insecurity challenges over the past decades, Vietnam faces a new set of complex, inter-related food problems relate to the supply, distribution, and quality assurance for fresh perishable foods. In urban Vietnam, income gains have resulted in dietary shifts beyond rice on such a magnitude that these fresh foods now account for two-thirds of consumer food expenditures (figure 3.2), nearly double their share in the early 2000s. While much of this consumption and expenditure growth in fresh produce in urban areas has been serviced by Vietnamese farmers and market intermediaries, imports, especially of higher quality or different varieties of produce, have also surged in recent years. This new market presents enormous opportunities for Vietnamese farmers and food business operators, but only if they can meet consumer expectations for quality and safety, mobilize and deliver the products on a timely, reliable and cost competitive basis, and do so with limited negative impact on the environment (World Bank 2016a; Zorya and others 2018).

FIGURE 3.2. **Share of Food Expenditure on Different Types of Food, by City and Income Group**

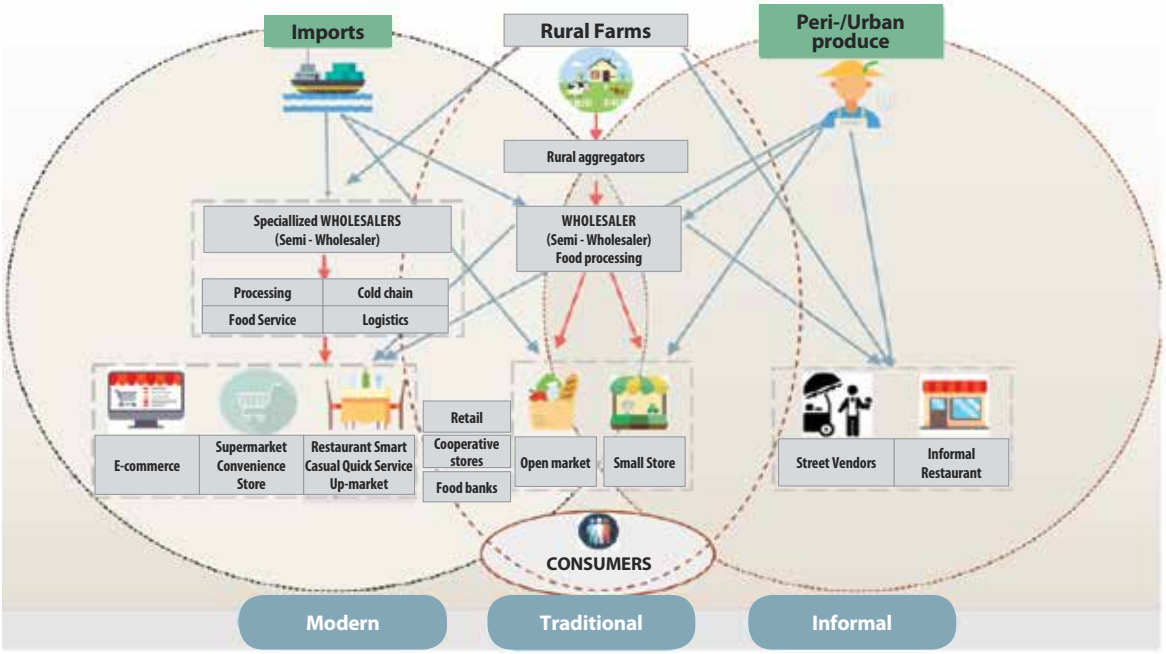


Source: Umberger and others 2017.

The sourcing, urban distribution, and quality assurance of fresh perishable foods represent a comparatively new set of connectivity issues in the Vietnamese economy. Legacy patterns of agricultural and food market organization and practices, together with the persistence of traditional food preferences (for example, to purchase "warm" meat or live animals) generate major challenges for food value chain modernization and governance (see figure 3.3). Despite some broader structural changes in the economy, the supply and distribution channels for perishable foods have undergone

remarkably little change. Primary production, aggregation, and subsequent distribution remain highly fragmented and only a small proportion of marketed output can be traced to its origins. This presents a problem given the multifaceted risk profile of many perishable foods. As a result, much of the delivery system servicing Vietnam's major cities for fresh perishable foods experiences very high levels of physical and product quality losses, frequently provides consumers with produce contaminated by chemical or microbiological hazards, and generates negative environmental impacts. Each of these dimensions entail large economic costs for cities, their residents, and their rural hinterlands.

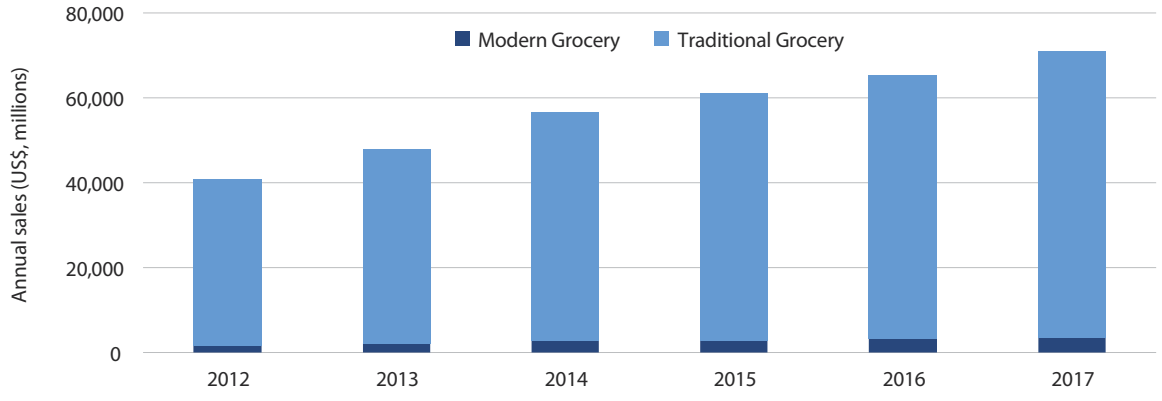
FIGURE 3.3. **The Complexity of Urban Food Systems**



Source: Tefft and others 2017.

While the number of "modern retail" outlets has grown rapidly in Vietnam's urban areas, their market share remains insignificant compared to their traditional counterparts. Between 2012 and 2017 the number of supermarkets in Vietnam doubled while the number of modern convenience stores grew five-fold, starting from a small number. However, as figure 3.4 illustrates, the market share of such modern outlets remains insignificant, albeit increasing slowly, when compared to small traditional wet markets, street vendors, and small stalls and shops. As of 2017, Vietnam has just over 1,000 supermarkets, but its 426,000 street stalls and kiosks produce combined sales 23 times that of the supermarkets. Traditional outlets still account for an estimated 95 percent of grocery retail sales nationwide, except for HCMC where modern retail outlets account for more than 15 percent of grocery sales.

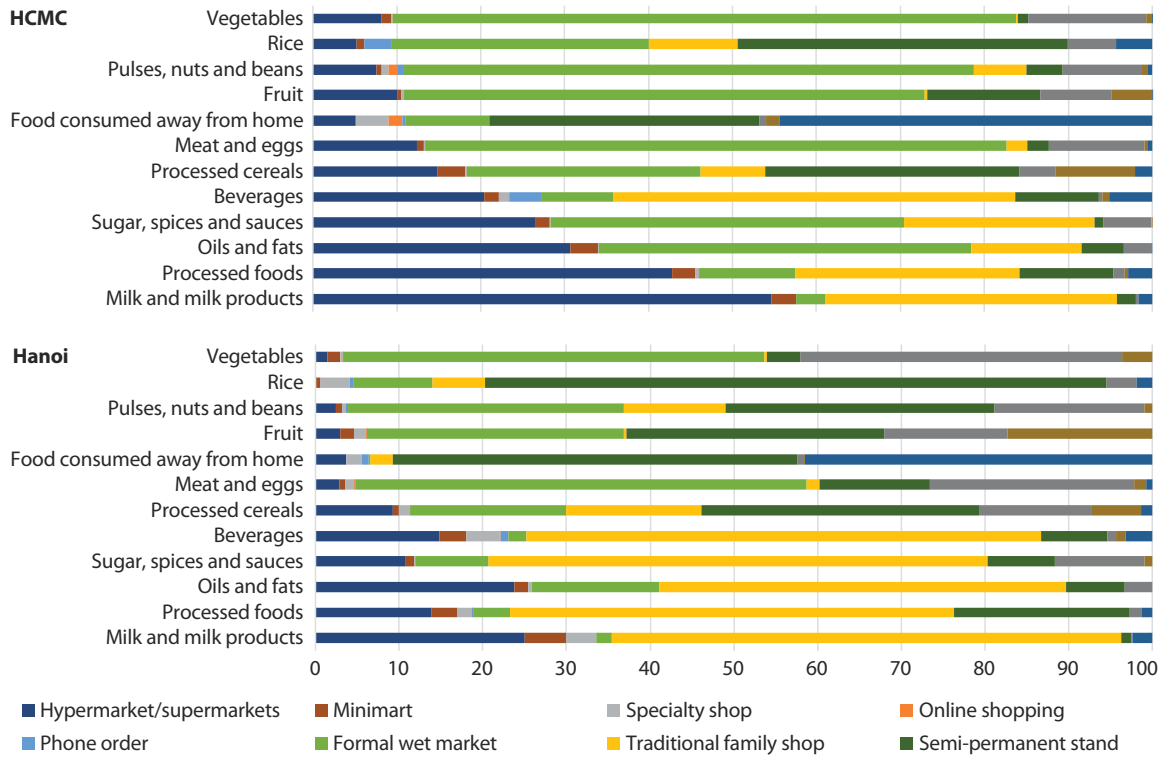
FIGURE 3.4. **Grocery Retail Sales by Distribution Channel in Vietnam**



Source: USDA Foreign Agricultural Service 2018, based on Euromonitor data.

And, the predominance of traditional outlets is even greater specifically in relation to fresh perishable foods. In Vietnam, supermarkets and other modern food outlets account for a significant share of food spending for dairy products, processed foods, vegetable oil, and spices/condiments alone. This can be seen in figure 3.5. For Hanoi, more than 90 percent of consumer spending on fruits, vegetables, meats, and eggs still occurs in traditional outlets, with the wet markets by far the most important locale. Hanoi has 454 such markets, located in nearly every residential neighborhood.

FIGURE 3.5. **Average Share of Monthly Food Expenditure by Type of Outlet**



Source: Based on Umberger and others 2017.

Beyond the preference for "warm" meat, the convenience, proximity and more attractive pricing are added benefits of shopping at traditional grocers. For urban consumers, conveniently located wet markets and informal street markets offer a wide range of (generally very fresh) fruits, vegetables, and animal products, flexible packaging sizes, and negotiable prices. Most shoppers walk to these venues or carry small loads on bicycles or motorbikes. Traditional vendors have very low rental and operational costs, which help them keep prices low. On the other hand, shopping at modern markets often requires more time and distance. Only a small proportion of mostly higher income urban residents, who self-claim to be conscious about quality and food safety, regularly purchase fresh produce in supermarkets, where produce tends to be less diverse and less fresh, yet often more expensive than in the traditional outlets.

Benchmarking the status quo

In a modernizing domestic market for high value perishable foods, effective connectivity includes—and extends well beyond—efficient product handling and logistics, meaning the physical management of product flows from rural areas to end users (and even beyond with the disposal or repurpose of unconsumed food). It also involves effective farm-to-market information flows pertaining to the product as well as its origins, quality characteristics, biosecurity status, and its production processes. Multiple functions must be undertaken and relationships developed to regularize or institutionalize all of this. In fact, a well-connected, well-performing market system for perishable foods would feature the following attributes and capacities:

- Farm and Enterprise Quality, Environmental, and Supply Chain Management Practice
  - Widely applied (and enforced) set of regulations and private standards for product and environmentally safe farming practices
  - Widely apply good management practices by food business operators to address biosecurity, food safety, and environmental risks
  - Effective institutional capacities for aggregating farm produce and tracing its origins
  - At-scale development of short value chains involving direct sourcing, e-commerce, and so on.
- Logistics Capabilities and Market Infrastructure
  - Effective capacities for physical logistics, including cold chain services and appropriate regulations for transporting food from source to final market and service outlets
  - Integrated network of modern hygienic physical markets performing multiple wholesale and retail functions
- Effective Regulatory Measures
  - Effective official controls in place for disease control, quarantine, and other biosecurity measures
  - Effective official controls in place for product food safety surveillance, testing, and recall
  - Effective system in place combining regulations, incentives, and technologies to minimize and repurpose food waste
  - Well-developed system of food labeling and sustainable packaging

Set against such criteria, the current state of Vietnam's market system and governance of perishable foods for the domestic market is underdeveloped and, in some areas, rudimentary. A closer look at farm practices reveals that even after many initiatives by government agencies and development partners to promote safer or more sustainable farm practices—through advisory support and investments—certified adoption rates remain modest. VietGAP-certified farms currently account for just 3 percent of the harvested area of fruit and vegetables; farms certified organic account for an even smaller share, at 0.8 percent, due to various reasons including costs, the public's lack of knowledge about where it can be purchased as well as the lack of underlying knowledge about the meaning of "certified organic" logos and the production practices affiliated with them.

Now, considering market infrastructure: Most of Vietnam's approximately 83 food wholesale markets and nearly 2,000 community wet markets, which continue to account for bulk of perishable food sales in the country, are 20 to 30 years old. In addition, the vast majority have not undergone recent renovations to improve hygiene, waste management, or foot and vehicular access.

Take the case of "cold chain," which refers to refrigerated transportation and storage of perishable foods—essential to ensure safety and freshness of food. Vietnam's cold-chain market has grown rapidly in recent years to reach an estimated market size of US$169 million (FiinGroup 2019). However, most cold storage operations serve the export market; while cold transportation segment is rapidly growing, the market is highly fragmented with many small players who have limited financial capabilities.

While Vietnam has implemented a vast set of laws, regulations, and guidelines around the market chain for perishable foods, enforcement gaps persist. Multiple ministries and levels of government have been designated to handle or share the mandates to induce, prohibit, or constrain various types of practices and behavior across all stages and players in the farm-to-market chain for perishable foods.[3] Despite the presence of this regulatory framework, the main challenge relates to enforcement or the lack of effective incentives to induce widespread voluntary compliance with regulations. With its highly fragmented structure of food production, intermediation, and distribution, full regulatory oversight is impossible given the current human and financial resources available to government. And, in many ways, broad regulatory enforcement has not been an operative objective in Vietnam's agro-food system. For decades, the overriding goal has been output expansion with an emphasis placed on intensification. Any misuse of inputs or adverse environmental externalities have been tolerated as side effects from the drive to expand output.

The consequences of poor connectivity and practices

A growing body of evidence points to inefficiencies in domestic value chains for perishable foods as well as serious problems related to food safety and environmental management. This translates into significant economic and social costs and in low levels of consumer confidence and satisfaction. The latter, if not effectively addressed, could weaken the competitiveness of Vietnamese farms and food enterprises in the longer term. Some of this evidence is highlighted here. For example:

First, physical food loss throughout the food chain is significant due to fragmented distribution systems, including the lack of cold storage or refrigerated transport services. A 2018 survey of 150 farmers and enterprises who are prominent suppliers of fresh produce to the HCMC market shows estimated physical product losses of nearly 25 percent, including 32 percent for fruit and vegetables, 14 percent for meat, and 12 percent for fish, only until intermediate distribution points. Estimated losses could be far greater if totals included those incurred during the food processing and final retail distribution phases. Very little use of cold storage or refrigerated transport services occurs in the domestic market, especially the market servicing the traditional distribution channels.[4] If these rates of product loss represent the national picture, then total national losses of such high-value perishable foods would amount to nearly US$3.9 billion, equivalent to 12 percent of Vietnam's agricultural GDP and 2 percent of its total GDP.

Second, the supply chain for perishable foods is generating enormous amounts of food and other organic waste; much of this waste is mismanaged which results in significant environmental consequences and high economic costs. In urban Vietnam few active programs exist to prevent or repurpose food waste. As a result, food waste now dominates landfill sites and contributes significantly to adverse environmental impacts. In HCMC, for example, only about 10 percent of food waste, more than 80 percent of the volume of HCMC's landfill, is collected and converted into compost; none is converted to industrial uses or bioenergy (Ngoc, Nguyen, and Ngoc 2018). The three wholesale markets in HCMC spend more than US$100,000 per month dealing with garbage or treating waste. Food waste often ends up in canals, ponds, and other surface waters, clogging waterway traffic and contaminating water used for drinking, recreation, or fishing. Thus, instead of being mobilized as a valuable resource, organic waste imposes large environmental and economic costs.

Third, mixing cities and animals has translated into a biosecurity risk. A long-standing preference for purchasing "warm" meat has resulted in large movements of live animals to Vietnamese cities and their slaughter in close vicinity to residential areas. Each day, some 150,000 chickens are moved, sold, and slaughtered in both Hanoi and HCMC. On an annual basis this translates into 55 million chickens. Many of these are channeled through live bird markets, which are typically responsible for transmission of avian influenza that threatens public health (Fournie and others 2012). City food systems and food waste are also likely playing a significant role in the spread of African Swine Fever (for which no known controls exist) and which results in 100 percent mortality for affected pigs. ASF can be spread not only by infected animals, but also through raw meat transported from place to place, converted into feed scraps, or found in organic waste.

Fourth, marketed perishable foods have high rates of microbiological and chemical contamination, with the most serious issues related to meat. For example, in a recent study, Nguyen and others (2018) found the presence of non-typhoidal *Salmonella*—a leading source of foodborne diseases for nearly 900,000 illnesses annually—in 71 percent of chicken samples taken in Hanoi and HCMC. The *Salmonella* prevalence rate was higher in wet markets (90 percent) than in supermarkets (53 percent). Ministry of Health statistics indicate that over the 2011 to 2016 period, seven foodborne diseases impacted an average of 669,000 people per year (National Assembly 2017). Other estimates, taking into account a broader range of foodborne diseases, suggest that more than

ten times this number of Vietnamese citizens are sickened (and 3,500 people die) each year from unsafe food. In fact, the proportional incidence of foodborne illness per 100,000 people is higher in Vietnam than in any other country in Asia.[5] The public health burden of foodborne disease in Vietnam is now on par with that of tuberculosis and HIV/AIDs. Jaffee and others (2019) estimate that Vietnam's annual productivity loss (due to loss of work, disability, and premature death) from foodborne disease amounts to some US$740 million per year. The medical costs of treating foodborne illness in Vietnam likely exceed US$200 million per year.

Given the above, not surprisingly, Vietnamese consumers rate food safety as their number one social concern. A growing number of recent surveys have sought to gauge consumer attitudes and concerns about food. While some surveys reveal concerns about matters of nutrition and dietary quality, by far the strongest and most widespread concerns pertain to food safety. Remarkably, the lack of trust in the local food safety is almost universal. A 2018 survey conducted in multiple Vietnamese cities found 89 percent of respondents characterizing local food as "unsafe," echoing a 2016 survey that found middle- and upper-income consumers in Hanoi to either be worried (30 percent) or extremely worried (67 percent) about food safety (Rikolto 2016). An April 2019 survey of social concerns among Hanoi and HCMC households ranked food safety as the number one concern, far outpacing issues of pollution, access to social services and education, and other issues. Vietnam is likely the only country in the world where such a large number of citizens rank food safety the number one social concern.

The above economic, environmental, and public health issues associated with food safety are likely to continue to increase over time, along with further dietary changes toward intrinsically more hazardous foods. Therefore, it is critical to overhaul the perishable food chains in all aspects, ranging from the regulatory framework and investments in market infrastructure, to transportation and logistics services and an enforcement system.

Emergence of E-Commerce in Vietnam

As is the rest of the world's economies, Vietnam's economy is heading toward the "digital economy," with its economic entities—producers and consumers alike—increasingly reliant on various digital technologies for information gathering, communication, transactions, and decision-making. E-commerce is a critical part of such trends. The Organisation for Economic Development and Co-operation (OECD) and the World Trade Organization (WTO) provide two generally accepted definitions of e-commerce. OECD defines e-commerce as the "sale or purchase of goods or services conducted over a computer network by methods specifically designed for the purpose of receiving or placing of orders," while WTO defines e-commerce as "the production, distribution, marketing, sale, or delivery of goods and services by electronic means."

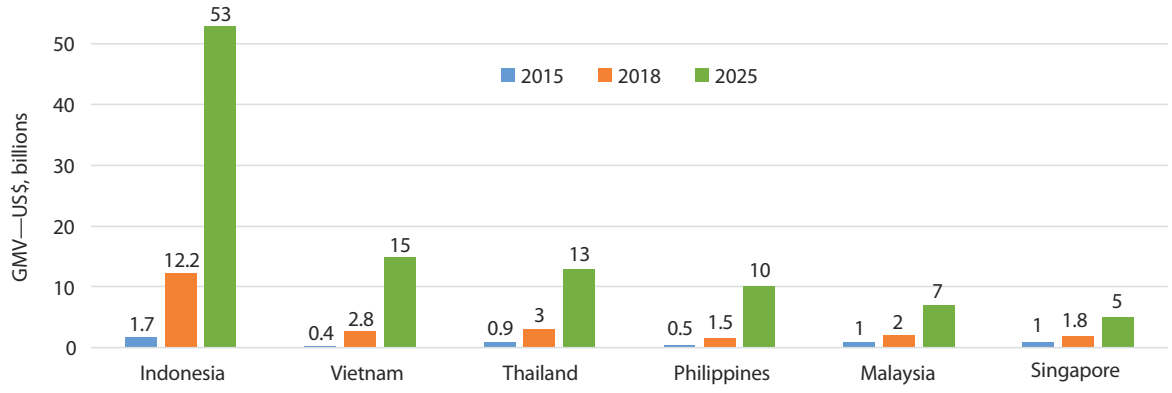
The digital technologies driving this transition toward the digital economy provide opportunities for growth and enhance inclusivity, by increasing productivity of firms, lowering costs of information and transactions, and lowering information barriers. This growth potential also applies to a vibrant and competitive e-commerce, which could lower inventory and transaction

costs, help small- and medium-sized enterprises (SMEs) reach a broader customer base than through traditional marketing, and improve convenience and consumer satisfaction. At the same time, digital technologies alone are not sufficient to bring about these positive outcomes; rather, the "analog" foundation, such as right regulations, adequate skills and strong institutions would enable the countries to reap such benefits (World Bank 2016b).

Projections show e-commerce in Southeast Asia, including in Vietnam, growing rapidly. According to one estimate, the e-commerce market in Southeast Asia is estimated to grow from US$23.2 billion (gross merchandise value) in 2018 to US$102 billion by 2025 (Google and Temasek 2018). The three largest e-commerce firms in the region—Lazada, Shopee, and Tokopedia—grew collectively between 2015 and 2018 by a factor of seven, while the next seven largest players grew by a factor of two during the same time. This rapid growth in e-commerce has been fueled by growing incomes, consumer demand and preferences, increased mobile penetration, and improving logistics networks. This growth is also expected to change the dynamics of competition and growth. E-commerce players are expected to expand from major cities such as Hanoi and HCMC to secondary cities such as Can Tho and rural areas with lower e-commerce penetration—but higher growth potential—making connectivity and logistics more important for sector growth going forward.

Vietnam is Southeast Asia's third largest e-commerce market after Indonesia and Thailand and is set for continued growth. Shown in figure 3.6, Vietnam is Southeast Asia's third largest e-commerce market after Indonesia (US$12.2 billion in 2018) and Thailand (US$3.0 billion in 2018), having grown from US$0.4 billion in 2015 to US$2.8 billion in 2018. Key factors for Vietnam's e-commerce growth include a relatively large population of 92 million people, an emerging and rapidly growing consumer class comprising 70 percent of the population, and a healthy economy with an average growth rate of 5.9 percent over the past 10 years.

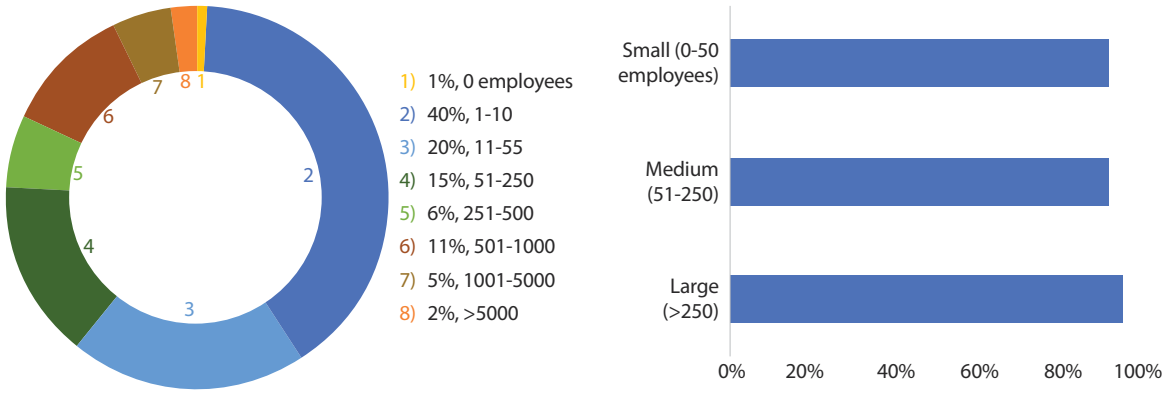
FIGURE 3.6. **Actual and Projected E-Commerce Market Size in Southeast Asia, 2015–25**



Source: Google and Temasek 2018.

As shown in figure 3.7, **Vietnam-based merchants engaging in e-commerce are mostly SMEs: 40 percent employ 10 or fewer people and 75 percent have fewer than 250 employees,** according to the forthcoming World Bank E-Commerce Development Survey.[6] This composition compares with the overall landscape of domestic private sector firms: While the number of domestic private sector firms has been increasing since the year 2000, the average size of firms (by number of employees) has been decreasing to approximately 15 employees. As noted in a recent World Bank report, the acceleration of Southeast Asian e-commerce has been facilitated by the surge of marketplaces where SMEs sell to consumers by providing scalable, readily-accessible platforms where smaller retail players and merchants can transact online and reach new consumers (World Bank forthcoming). Most e-commerce merchants in Vietnam are involved in food products, electronics, and clothing and footwear; a majority (58 percent) of e-commerce merchants sell and buy online, while 32 percent only sell online.

FIGURE 3.7. **Key Characteristics of E-Commerce Merchants in Vietnam**



Source: World Bank forthcoming.

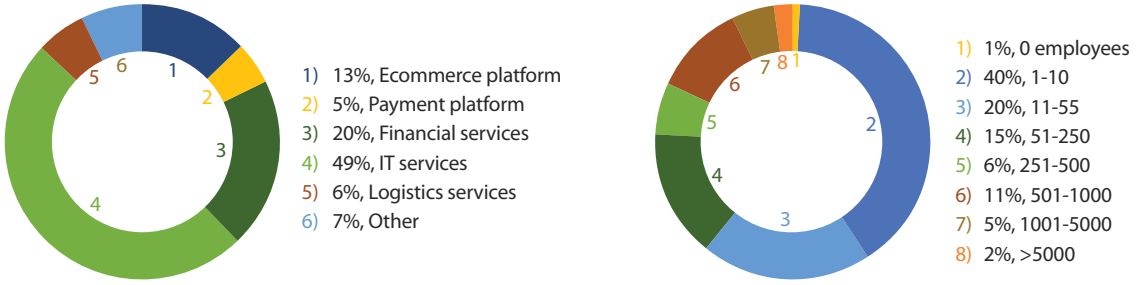
A number of sectors participating in the Vietnam e-commerce ecosystem have uneven market conditions and levels of development. Facilitating a large number of small-size e-commerce firms to deliver goods and services in a timely, cost-efficient, and convenient manner to customers, requires a well-functioning e-commerce ecosystem made up of players in various interrelated sectors. The most critical sectors in the ecosystem include information technology (IT) services, financial services, e-commerce platforms, logistics services, and payment platforms (see figure 3.8). Several factors determine the current level of development and market conditions, including market demand, barriers to entry, regulatory constraints, and availability of finance. For example, in financial services and payment platforms, the high number of unbanked and the high use of cash payments has led to new players coming into the ecosystem—such as MoMo Mobile Money, a mobile wallet and payment application. In logistics, inefficient and fragmented supply and logistics chains have led to new players emerging in the ecosystem—such as LOGIVAN, an e-platform for improving truck utilization, and Giao hang nhanh (GHN), a last-mile delivery firm.

On the positive side, investment in start-ups and in existing e-commerce and e-commerce related firms in Vietnam have increased significantly over recent years. According to data from start-up accelerator firm Topica Founder Institute (TFI), in 2018, investments in Vietnamese

startups reached US$889 million (with a total of 92 deals), nearly triple the deal value compared to US$291 million in 2017. The top five sectors in terms of 2018 investments were fintech, e-commerce, travel tech, logistics, and educational tech. Encouraging and promoting enabling regulations and policies that support start-ups will help the Vietnam e-commerce ecosystem continue to grow and attract investment, especially in area—such as Fintech—that require more regulatory clarity.

At the same time, most firms in the e-commerce ecosystem are SMEs, with limited ability to scale and grow. As seen in figure 3.8, a majority of firms (40 percent) in the e-commerce ecosystem have been 1 and 10 employees, while a further 20 percent have between 11 and 50 employees, meaning a majority of firms in the ecosystem are SMEs, in line with firm composition in the general economy.

FIGURE 3.8. **Key Characteristics of E-Commerce Ecosystem in Vietnam**



Source: World Bank forthcoming.

International experience suggests several factors enable vibrant development of e-commerce, and more broadly of digital economy. Among these are digital connectivity, payments, digital skills, logistics, and digital policy and regulations, according to the priorities identified in the World Bank report, *Digital Economy in Southeast Asia: Strengthening the Foundations for Future Growth* (Beschorner and others 2019), and listed in table 3.2.

TABLE 3.2. **Digital Economy Foundations and Priorities**

Digital connectivity	Affordable broadband internet access is a prerequisite and a physical underpinning to the digital economy
Payments	Access to safe and secure digital payment services provide the opportunity to engage in electronic transactions either as consumers or entrepreneurs, domestically or overseas
Digital skills	In a digitally-driven economy, skill needs range from basic digital and data literacy, to specialized skills to harness the productivity benefits of digital innovation
Logistics	The expansion of the digital economy highlights the importance of a developed and cost-effective logistics sector given the higher demand for delivery of goods, especially at low values, both within and across borders.
Digital policy and regulation	Cross cutting policies and regulations shape the digital economy, including: those which relate to cross-border data flows, data privacy, cybersecurity, consumer protection, electronic transactions and e-commerce laws and taxation.

Source: Beschorner and others 2019.

Vietnam's performance in terms of digital economy enablers compares to that of its peers in Southeast Asia, except for payments. On digital connectivity (see table 3.3), 82 percent of the population in Vietnam has access to mobile broadband, while only 12 percent have access to fixed broadband (most e-commerce consumers tend to use mobile broadband). In terms of payments, only 10 percent of people paid online for internet purchases, a level that is significantly lower than Indonesia and Malaysia, implying that 90 percent of e-commerce consumers in Vietnam use cash to buy online. Among online firms, 51 percent use digital payments, about equal to the Southeast Asia average. From a logistics perspective, Vietnam's Logistics Performance Index (LPI) score is the same as Indonesia, but behind Malaysia and Thailand. On skills, using the Human Capital Development Index, Vietnam lags behind Malaysia, Thailand, and the Philippines. Regarding policy and regulations, Vietnam's heavy restrictions on cross-border data flows can constrain e-commerce activities, while its data privacy regulations and consumer protection regulations are deemed to have generally positive impacts on the development of e-commerce.

TABLE 3.3. **Digital Economy Enablers in Southeast Asian Countries**

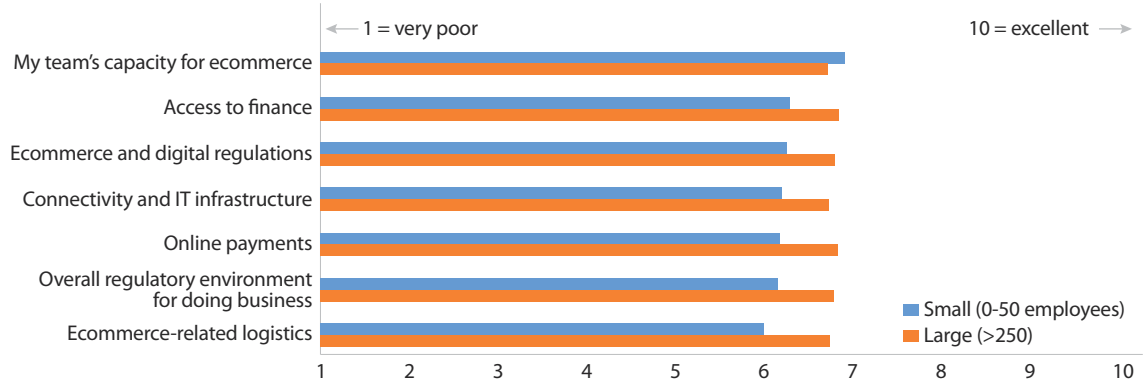
		Vietnam	Indonesia	Thailand	Malaysia	Philippines
Digital connectivity	Mobile broadband subscribers (% of population)	82%	100%	170%	116%	40%
	Mobile broadband prices (500MB/month) as a % of GNI per capita	1.4%	1.4%	1.2%	0.9%	1.5%
	Fixed broadband subscribers (% of population)	12.0%	3.1%	11%	8%	3%
Payments	Made or received digital payments in the past year	22%	34%	62%	76%	23%
	Paid online to buy on Internet	10%	49%	—	52%	—
	% of online firms using digital payments	51%	51%	—	57%	52%
Logistics	Logistics Performance Index score (out of 5)	2.98	2.98	3.26	3.43	2.86
	Integrated index for postal development	47.8	49.4	66.1	66	33.9
Skills	Human Capital Development Index global rank (out of 120)	68	69	57	52	46
Policy and regulation	Cross-border data flow restrictions	Yes	Yes	No	Yes	No
	Data privacy regulations	Yes	Yes	Yes	Yes	Yes
	Consumer protection regulations	Yes	Yes	Yes	Yes	Yes
	Cybersecurity expenditure (% of GDP)	0.04%	0.02%	0.05%	0.08%	0.04%

Source: Beschorner and others 2019.
Note: — = not available.

A recent survey of e-commerce firms in Vietnam identified logistics related to e-commerce-as the most critical constraints to further development of e-commerce, especially for small firms. This critical constraint is followed by digital regulations and online payment (see figure 3.9). The gap between large firms and small firms is largest on e-commerce related logistics, suggesting

smaller firms face challenges in organizing e-commerce logistics for goods delivery. The growth of e-commerce in Vietnam, spurred by a raising middle class and a growing economy has led to higher demand for goods delivery—in particular of smaller parcels within and across borders—with greater emphasis on cost and timeliness.

FIGURE 3.9. **Top Three Constraints for Small E-Commerce Firms in Vietnam**



Source: World Bank forthcoming.

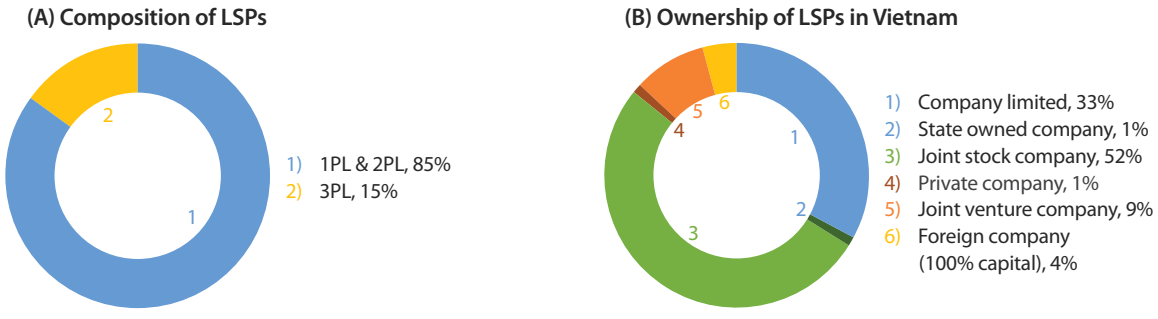
Challenges and Opportunities for Logistics Services

Development and limitations of logistics service providers in Vietnam

Logistics service providers (LSP) in Vietnam consist of diverse businesses, but asset-based, more basic operations, dominate when compared to the international trends. As shown in figure 3.10A, the majority of LSPs in Vietnam (85 percent) are involved in 1st or 2nd Party Logistics (1PL and 2 PL). 1PL is when a firm or individual has their own cargo and arranges transportation of goods from one point to another. 2PL represents an asset-based establishment, such as trucking companies, shipping line and airlines, which either owns or leases assets and transports goods for another party. About 15 percent of LSPs in Vietnam are 3PL operations, which provide outsourced logistics services to companies for part or sometimes all of their supply chain management functions. Very few operations in Vietnam are involved in 4PL, which is an independent non-asset-based integrator who integrates its own resources, capabilities, and technology (including 3PLs) to provide supply chain solutions for clients.

Foreign ownership of LSPs in Vietnam is low, with around 4 percent of LSPs 100 percent foreign owned. The majority of LSPs in Vietnam are Joint Stock Companies (52 percent), as illustrated in figure 3.10B. Foreign Ownership Limits (FOL) are 100 percent in key sectors such as storage and warehouse, freight transport agency (including freight forwarding services), distribution (import and export, commission agents, wholesale, and retail). The ascension of Vietnam to the World Trade Organization in 2007 led to greater foreign participation in the logistics sector, especially in the express services sector. However, FOL in other sectors is set at a much lower rate: for example, at 51 percent for road transportation, which might be limiting benefits that could be brought with increased foreign ownership, such as skills and new technology as well as access to capital and markets.

FIGURE 3.10. **Key Characteristics of Logistics Service Providers in Vietnam**

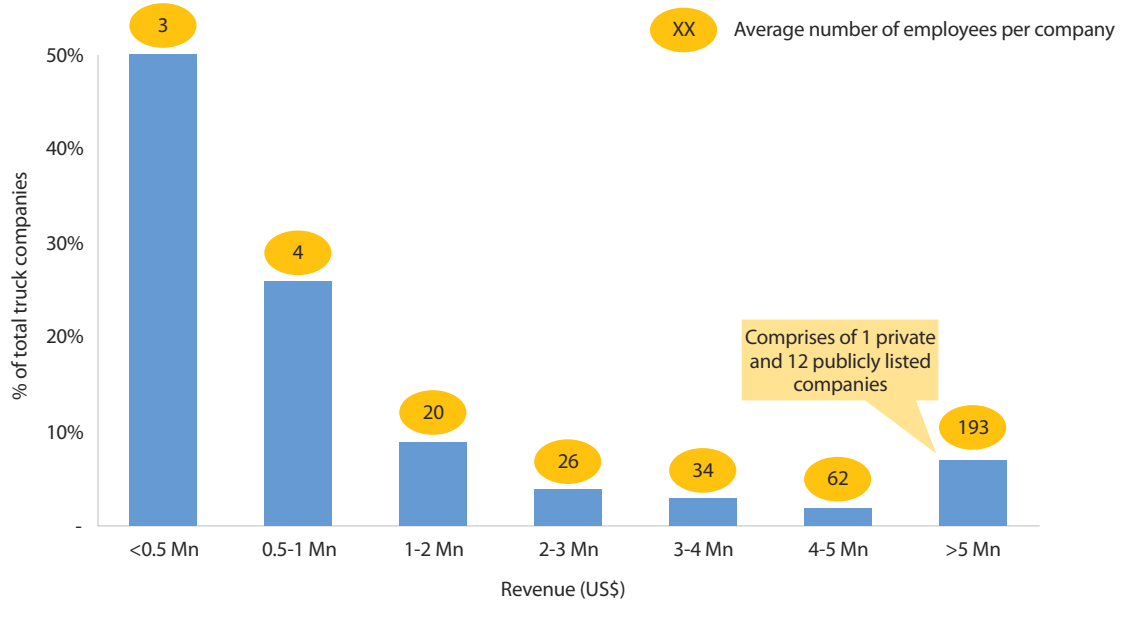


Source: FiinGroup 2018.

Source: VLA 2018.

The above discussion relates to the fact that LSPs in Vietnam are bifurcated between a well-endowed segment that services FDI sectors and a small-scale fragmented segment. Many foreign direct investments (FDIs) rely on seamless transportation and logistical arrangement to import input components and to export final assembled products. Many of the joint venture (JV) LSPs serve FDI sector customers, who often have a share in the JV, and provide services covering a large part of their supply chains. On the other hand, LSPs serving domestic customers have more basic operations (mostly asset-based 2PL services), and are small in scale and geographically fragmented. Vietnam has no pan-Vietnam truck brokerage service that could efficiently integrate cargo owners and shippers at low costs. This gap results in high logistics costs and a high share of empty backhaul of truck operations. As shown in figure 3.11, about half of all trucking companies generate annual revenues less than US$0.5 million.

FIGURE 3.11. **Distribution of Trucking Companies by Revenue**



Source: Lam, Sriram, and Khera 2019.

In addition to the fragmentation, freight brokerage services are underdeveloped in Vietnam, contributing to the inefficiency with the reported empty backhaul as high as 50 to 70 percent.[7] In Vietnam, limited freight consolidation is a key factor contributing to this high empty backhaul rates across the country. While there are some new entrants in the freight aggregator market, a notable lack of pan-Vietnam brokerage operation—partly due to the limited scale—has resulted in a limited use of technology in logistics solutions, which could help improve the efficiency. The innovative models of digital freight aggregators use information and communication technology for an algorithmic, real-time matching of supply-demand and route optimization, and can help in reducing backhauls as well as improving the efficiency of the truck sector in general. Freight consolidation could also potentially find work-arounds for seasonality, and other unavoidable factors contributing to empty backhauls and lighter truckloads during certain months of the year.

Emerging Challenges and Opportunities for LSP

Last-mile delivery is the final segment of the logistics chain where goods are transferred from the fulfillment center of the Business to Customer's (B2C) home or collection point. Timeliness, reliability, cost, and convenience in delivery are becoming increasingly important factors in last-mile delivery for e-commerce companies. The growth of e-commerce has led to a growing number of smaller parcels, leading to increasing logistics challenges. For urban deliveries, the challenges for urban logistics include traffic and congestion, truck access, and off-hour delivery. In contrast, cost, distance, and lack of facilities and infrastructure comprise the challenges of rural deliverables. While larger e-commerce firms can afford their own fleets (that is, 1PL), most e-commerce firms use a combination of 1PL, 2PL, and 3PL—and in limited cases—4PL.

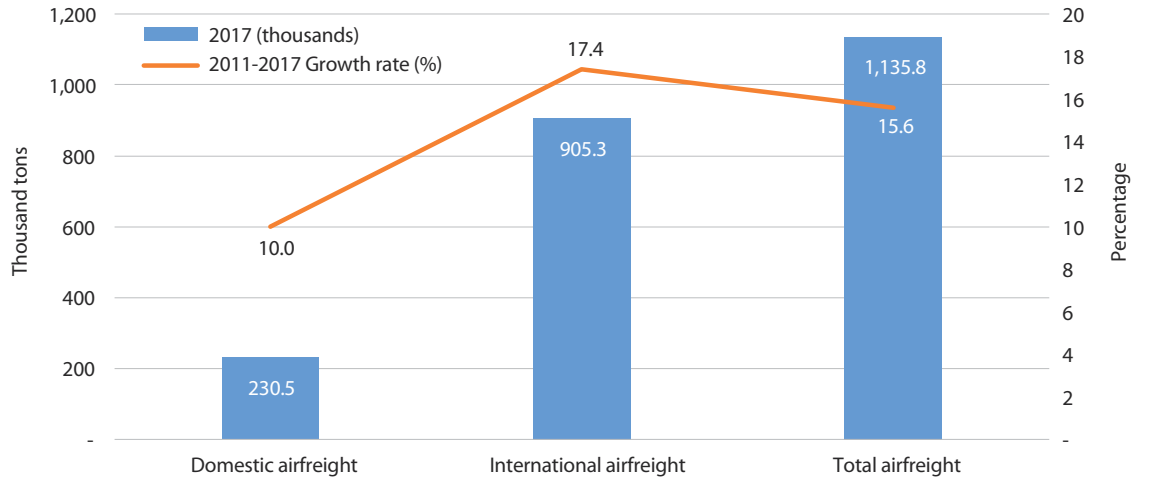
Postal services are adapting to the rise of e-commerce and companies such as Vietnam Post and Viettel Post are taking advantage of these new opportunities to increase revenue. A specific challenge for postal services and other last-mile delivering companies is whether parcels can be delivered or picked up at home addresses. According to the Universal Postal Union, 80 percent of the population of Vietnam have access to home delivery of mail; Singapore, Thailand, Malaysia, Brunei and the Philippines have higher rates.

While foreign express service companies such as DHL, FedEx, and UPS have a strong presence in Vietnam, the number of domestic partners is also on the rise. Some of these express services companies have set up specific e-commerce divisions to service e-commerce clients and some e-commerce companies, for example, Lazada Express, have also entered the express services market. Many foreign courier companies currently operating in Vietnam such as DHL, FedEx, Kerry Express, and other courier companies have dedicated terminals located at Tan Son Nhat airport. However, the majority of goods shipped by these companies are parcels and correspondence, so the volume of goods handled by these companies accounts for a relatively small proportion of total airfreight cargo volume in tons. With the rise of e-commerce, the contribution of the courier segment to total airline output will continue to increase in the future.

The Vietnamese airfreight market has grown by an average of 15.6 percent between 2011 and 2017 and stood at 1.1 million tons in 2017. While airfreight accounts for a small portion of

total goods volume in Vietnam, it accounts for 25 percent of the total export value of the country (mostly products such as electronics and textiles). Domestic airfreight accounts for about 20 percent of total airfreight, having grown at an average annual growth rate of around 10 percent from 2011 to 2017 (figure 3.12). The total volume of domestic goods reached approximately 230.5 thousand tons, an increase of 14.6 percent compared to 2016, with the highest share in Ho Chi Minh City (42.6 percent), Hanoi (39.3 percent), and Da Nang (6 percent).

FIGURE 3.12. **Airfreight Volumes and Growth Rates for Vietnam**



Source: Vietnam Association of Logistics Services Enterprises (VLA)/Vietnam Logistics Research and Development Institute (VLI) Survey 2018, conducted by the General Statistics Office.

While 22 airports operate in Vietnam, Noi Bai in Hanoi and Tan Son Nhat in Ho Chi Minh City account for the majority of airfreight, mostly due to the lack of specialized cargo areas and aviation logistics centers at the other airports. Among the airports in Vietnam, only four airports have separate cargo terminals and only two have onsite logistics centers. The remaining airports have no cargo terminals and handle cargo in passenger terminals. Domestic aviation firms are expanding, albeit from a low base (with a market share of 12 percent in 2017), in comparison to foreign firms. These domestic firms generally use passenger aircraft underbellies instead of dedicated freighter aircraft. And while e-commerce is increasing it use of airfreight, the volume is still very small.

Challenges of urban logistics[8]

With the rapid growth of cities such as HCMC and Hanoi, we must study the challenges around urban logistics—which often involve trips under 100 km—and the opportunities therein for improving operational efficiency and links with intercity freight movement. Companies involved in urban trucking are often the first- and last-mile delivery partners of intercity transportation companies. Some of the shorter trips (under 100 km) include the "drayage" of intermodal (or ISO) containers between a maritime or river port and its immediate urban and industrial hinterland. This section discusses the key challenges in the urban trucking operations through analyzing case examples of the two major metropolitan gateways, Hanoi and HCMC, focusing on the current traffic congestion, city regulations affecting the traffic flows, and the upcoming infrastructural plans.

Case study 1: Hanoi

The population density of Hanoi is as high as 2,300 people per square kilometer (km^2), compared to nearly 300 people per km^2 for Vietnam as a whole. Therefore, urban trucking companies face high levels of passenger traffic when running logistics services within the city, with over 70 percent of the road users riding mopeds. In addition, car ownership is also expected to rise, due to increasing disposable incomes. Together, the passenger and cargo traffic lead to high levels of congestion in the city. Government studies calculate that traffic jams in Hanoi cause VND 12.6 trillion (US$600 million) in economic losses every year (Saigoneer 2017). Analysis of the Directorate for Roads of Vietnam's (DRVN) commercial vehicle tracking system, or CVTS, show high congestion patches, particularly in the city center (figure 3.13).

FIGURE 3.13. **Traffic Density Representation in Hanoi Using CVTS Data**

Source: Lam, Sriram, and Khera 2019.

Hanoi also acts as a transit stop for importers and exporters operating out of the Haiphong port. Hanoi offers office space, and many logistics companies and distributors have opened offices and warehouses in the city center. Goods from Haiphong port are brought to the Hanoi-based warehouses and then dispatched throughout Vietnam, adding to the city's traffic congestion. However, building warehouses and consolidation centers near Haiphong port or in the city's outskirts would prevent this import–export traffic from moving into and out of the city, thus reducing congestion.

Another major source of cargo traffic derives from the logistics operations of e-commerce companies as well as the daily deliveries of restaurants, grocery stores, and other small enterprises. Interviews with logistics companies indicate inefficient intra-city road structures, insufficient overpasses, underpasses, and bridges, which all lead to high congestion levels. In such circumstances, city planning and zoning take on a greater importance, clarifying the need for the clear demarcation of commercial, industrial, and residential zones. Residential neighborhoods around industrial areas create challenges surrounding the combination of cargo and passenger traffic.

The city authority has taken some initiatives to streamline the traffic in the city. Cargo truck movement in the city is only allowed during off-peak hours from 9:00 p.m. to 9:00 a.m., which reduces peak-hour traffic congestion. However, the restricted timings also lead to congestion at city entry points during the restricted hours. Urban consolidation centers (UCCs) located at the city fringes serve as potential sites for freight consolidation for goods moving out of the city as well as freight deconsolidation into smaller trucks for goods moving into the city. In addition, UCCs could provide organized parking spaces for the larger trucks during restricted hours.

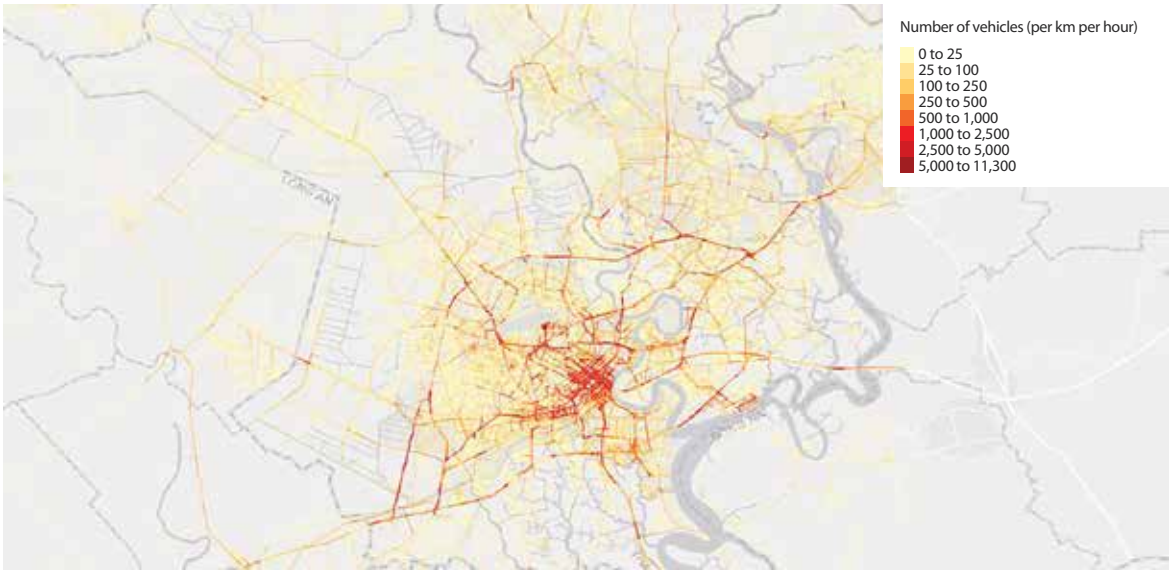
Case study 2: Ho Chi Minh City

HCMC is one of the densest cities in Vietnam, with approximately 4,000 people per sq. km of area. The CVTS data analysis of the province shows high congestion in the central city (see figure 3.14).

Factors attracting industries include the geographical advantages of HCMC with seaports and river ports and the availability of good quality human resources. While the population growth rate is a modest 1.46 percent, the migration rate is relatively high, at 3.8 percent per year. Because HCMC is an economic hub for Vietnam, a huge number of vehicle users come to the city, piling pressure onto the traffic infrastructure. Due to the presence of rivers, the region is also prone to seasonal flooding, which further adds to the city's traffic challenges.

A unique feature of HCMC—which distinguishes its traffic management from Hanoi—is the proximity of both Ho Chi Minh seaport complex and Tan Son Nhat airport to the city center (figure 3.15). The HCMC seaport complex is one of the most important ports for export and import in the country and serves as the main gateway for the region, accounting for 67 percent of the total throughput of all ports in Vietnam. Trucks used for the first- or last-mile delivery of containers and bulk goods from city ports into city centers contribute to the high levels of congestion.

FIGURE 3.14. **Traffic Density Representation in Ho Chi Minh City Using CVTS Data**



Source: Lam, Sriram, and Khera 2019.

With container terminals located in the city center, city roads—already highly congested with passenger vehicles—serve as access roads connecting the ports to the nearest highway, which accounts in part for the long delays in moving trucks between ports and ICDs. Consequently, these port access roads could benefit from additional lanes dedicated to moving cargo traffic. Further, the Cai Mep–Thi Via port, an underutilized deep-water port located around 80 km south of HCMC, can handle more throughput from the Ho Chi Minh port.

FIGURE 3.15. **Traffic Density Representation in HCMC Using CVTS Data (Zoomed)**

Source: Lam, Sriram, and Khera 2019.

Truck traffic in HCMC is also subject to timing restrictions. Laws recently put in place by the HCMC People's Committee restrict light trucks from entering the city's urban area during peak hours from 6:00 a.m. to 9:00 a.m. and from 4:00 p.m. to 10:00 p.m. In addition, heavy trucks and container trucks are not allowed in urban areas from 6:00 a.m. to 10:00 p.m. As discussed in the Hanoi case study, UCCs could potentially offer organized space for parking trucks and consolidating freight during restricted hours.

Issues around urban logistics is complex and involves various stakeholders with conflicting interests. Cities have daunting challenges of ensuring their citizens meet their daily mobility needs—such as commuting and other trips—while at the same time enabling goods movement for businesses and households, especially in light of increasing e-commerce. These issues are not easy to solve or inexpensive as regulations alone would not be sufficient to resolve them. Solutions would likely require significant investments in urban infrastructure including for public transport systems, relocation, new development or capacity expansion of various cargo handling facilities as well as less capital-intensive investments such as traffic management and regulations.

CHAPTER SUMMARY

- Compared to their poorer and more rural counterparts, Vietnam's richer and more urban consumer class consumes more fresh food, such as meat, fish and seafood, vegetables, and fruits, and less of traditional staples such as rice.
- Notwithstanding these changes in dietary habits, consumer shopping preferences have not changed. And thus, the food supply chains around the largest cities of Vietnam continue to rely on traditional wet markets and fragmented logistics chains, which lack the ability ensure necessary conditions for freshness and safety of fresh food.
- As a result, Vietnam's cities and their residents face some serious challenges, including massive loss of food during the supply chain, endemic issues around food safety due to various forms of contamination occurring throughout the supply chain, and a wide range of environmental pollution caused by unhygienic slaughtering practices in close proximity with urban density.
- Tackling such issues requires complex, multidisciplinary solutions applied to the entire supply chain "from farm to fork," including a regulatory framework, improvement and relocation of market infrastructure, development of a logistics service sector as well as promotion of good agriculture practices.
- E-commerce is growing rapidly in Vietnam and offers opportunity for growth, as it can improve productivity and lower the search and transaction costs both for producers and consumers. However, with the sector still at an early stage of growth and dominated by SMEs, creating an enabling environment is necessary.
- Along with its potential benefits, e-commerce also brings additional challenges, such as growing needs for new types of logistics services, involving door-to-door connectivity, last-mile delivery, and urban storages able to meet the demand yet provide proximity. All of these issues bring further challenges in Vietnam's fast-growing, congested cities, which also need to address conflicting urban mobility issues concerning daily commuters.
- Domestic air freight is growing rapidly due to income rises and emergence of e-commerce. While the current volumes are sufficiently handled in passenger plane cargo holds, this might not be sustainable in the long-term as volumes are rising, and seasonality of freight demand is not consistent with passenger demand. The limited cargo handling capacities at most domestic airports could also pose challenges for sector growth.
- Urban logistics in Vietnam's already built-up and congested large cities pose serious challenges to various stakeholders with conflicting needs. These problems would require creative and complex solutions involving various stakeholders such as urban commuters, cargo owners, businesses in urban areas, and logistics service providers.

NOTES

1. These thresholds are based on international income classifications. See World Bank 2019.

2. The volumes of traded perishable foods are enormous and growing fast. For example, on an annual basis, Hanoi and HCMC each consume from 325,000 to 350,000 tons of meat, 1 million tons of fruit and vegetables, and between 140,000 and 170,000 tons of fish.

3. MARD enforces rules related to the sale and use of agricultural inputs and shares with MoNRE oversight on how water and land is allocated and used. The operative Food Law designates different responsibilities for food safety oversight to MARD, Ministry of Health (MoH), and Ministry of Industry and Trade (MoIT), with distinctions across product lines and food system players. The MoT and municipal governments oversee regulations regarding the types of vehicles which may be used for transporting food and animals and restrictions on time or locations for vehicular movements.

4. Cold-chain warehousing capacity is estimated to have quadrupled over the past ten years, reaching approximately 450,000 pallets in 2017, with an estimated 20 professional cold storage providers in southern Vietnam and 40 in the north. Much of this storage is used for external trade, the pharmaceutical industry, and by supermarkets. Comparatively, much less investment has gone into refrigerated vehicles due to concerns about road quality, cost, intermittent use, ability to withstand high external temperatures, and lack of understanding of its full benefits (see Walsh 2018).

5. The best available estimates probably come from the work of the WHO-convened Foodborne Disease Burden Epidemiology Reference Group (FERG). Its findings were reported on a subregional rather than country-specific level. See Havelaar and others 2015.

6. This is comparable to the average size of all firms in Vietnam, at about 15 employees; 97 percent of all firms in Vietnam are SMEs, which make up 57 percent of all employment and 60 percent of total value added and wages.

7. According to the national survey conducted for Lam, Sriram, and Khera 2019.

8. This section is based on Lam, Sriram, and Khera 2019.

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CHAPTER 4

Delivering on "Last-Mile" Inclusion

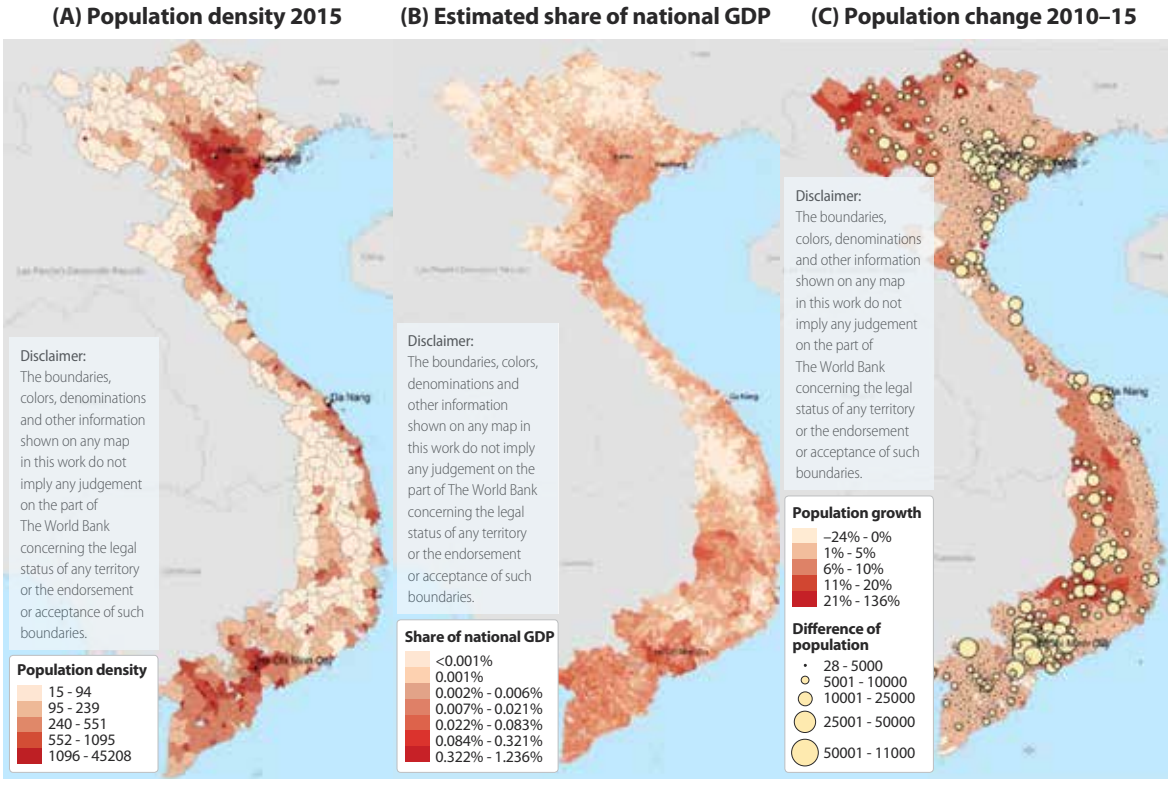
Obert Pimhidzai, Jung Eun Oh, Mathilde Lebrand, and Chiyu Niu

Vietnam has made remarkable achievement in near-universal access to all-weather roads, which connect almost all of its more than 10,000 commune centers. However, physical connection alone is not sufficient for reducing economic distance, as the connection must also link to areas that provide economic opportunities with sufficient economic density. This chapter examines how economic opportunities are spatially distributed in Vietnam, how different parts of the country are connected to these economic opportunities, and how and to what extent connectivity has affected their economic well-being.

Spatial Variation of Economic Densities and Outcomes in Vietnam

As urbanization and agglomeration continues, the already uneven distribution of population and economic activities in Vietnam is becoming more uneven. Vietnam is characterized by very low-density areas in the northern mountains and central highlands bordering Lao PDR and Cambodia as well as densely populated areas around Ho Chi Minh City (HCMC) and Hanoi (figure 4.1A). Economic activity measured in terms of estimated local GDP is even more concentrated than population in the communes of HCMC and Hanoi, as shown in figure 4.1B. The remaining activities spread along the coast and in the southern part of the country. Over the past decade, the most populated areas have grown the most in terms of population size, as a result of continued urbanization and agglomeration (figure 4.1C).

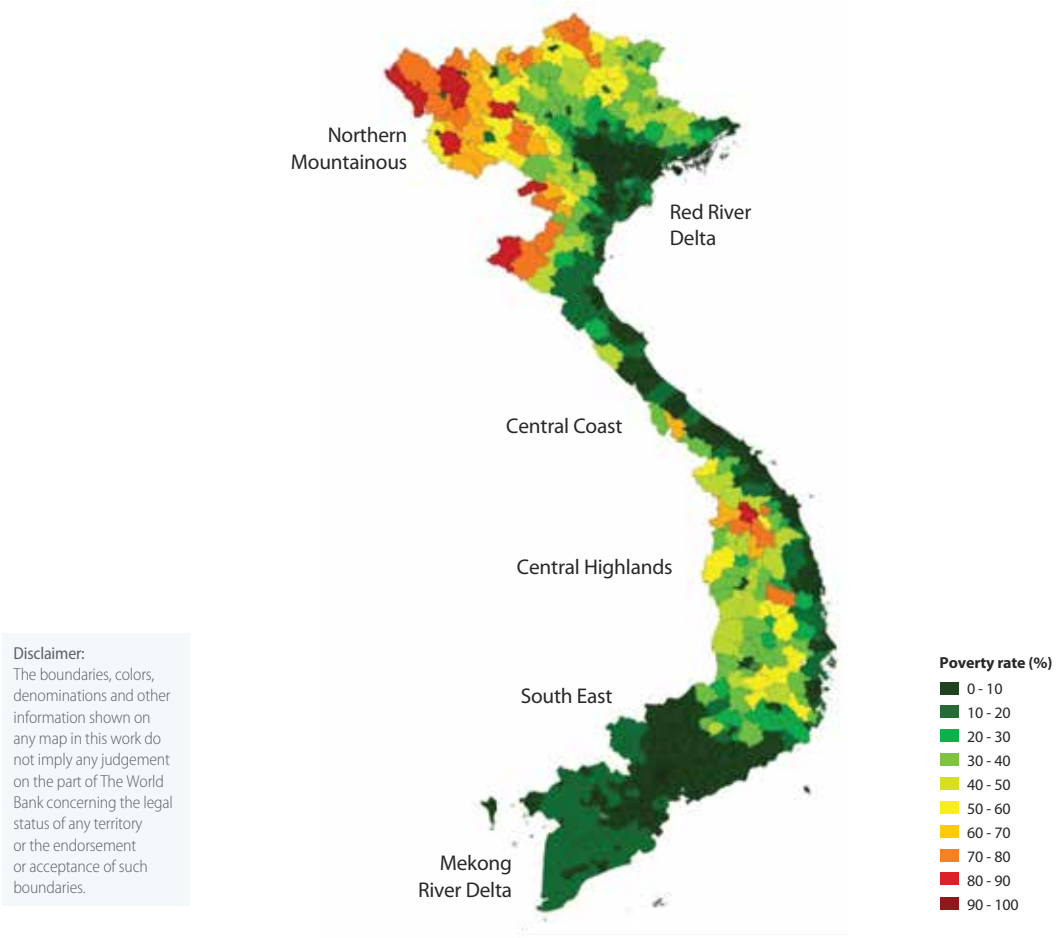
FIGURE 4.1. **Population Concentration and Economic Activities in Mainland Vietnam**



Source: World Bank mapping of data from the Population and Housing Census, conducted by the General Statistics Office (GSO), and night-time light analysis.

At the household and individual levels, we see a significant spatial variation in household welfare and economic outcomes. The incidence of poverty—based on the General Statistics Office and the World Bank (GSO-WB) poverty line in 2016—ranged from about 1 percent in the Southeast region to 24 percent and 28 percent in the Central Highlands and Northern Mountainous regions respectively. The substantial regional disparity of economic outcomes at the regional level results in more than 56 percent of the poor in Vietnam concentrating in the Central Highlands and Northern Mountainous regions, though they make up around 20 percent of the population. A more granular picture of the poverty pattern in Vietnam at the district level in 2014 shows a clear concentration of poverty in the northern mountain areas (figure 4.2).

FIGURE 4.2. **Poverty Map by District in Mainland Vietnam in 2014**



Source: World Bank estimates based on the 2014 Population Inter-Census and the 2014 Vietnam Household Living Standards Survey (VHLSS), both conducted by the GSO.

The remote and low-density population parts of Vietnam where productive opportunities are limited show lower median household incomes and more concentrated poverty. The incidence of poverty in coastal and inland delta communes hovers around 4 percent, but is more than 10 times higher in high mountain communes, where 44 percent of people are considered poor. The high mountain communes lie further from economic hubs—with an average distance of 300 km from the nearest major urban center—three times the average distance of inland-delta communes from major urban centers. High mountain communes also have a significantly lower population density, at 34 people per square kilometer compared to 257 people per km^2 in inland and delta communes. Thus, poverty is much higher in areas with the lowest economic density, presence of firms and access to non-farm wage jobs (table 4.1).

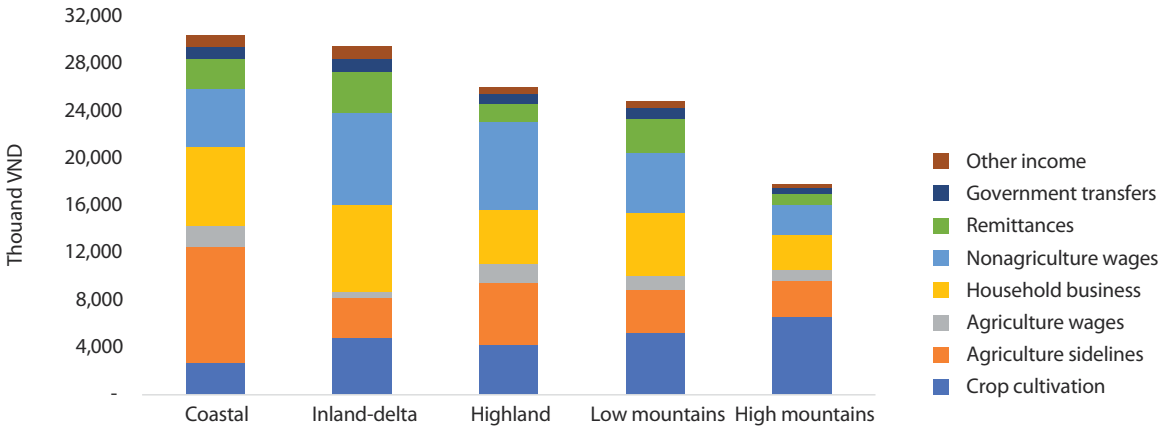
TABLE 4.1. **Commune Attributes by Topography**

	Coastal	Inland delta	Hills	Low mountains	High mountains
Poverty headcount rate (%)	3.9%	4.2%	4.2%	12.9%	44.4%
Share employed in non-agriculture wage jobs	30.7%	41.9%	41.0%	31.8%	18.4%
Share with post-secondary education	17.5%	22.8%	24.4%	23.4%	16.4%
Average distance to major cities (km)	196	108	127	196	301
Has a firm within the commune	89.3%	91.7%	93.3%	83.0%	57.0%
Population density (individual/km^2)	214.4	257.1	151.2	84.9	33.8
Share of ethnic minorities	3.2%	1.7%	0.7%	25.2%	68.7%

Source: World Bank calculations from the 2016 VHLSS, conducted by the GSO. See: https://www.gso.gov.vn/default_en.aspx?tabid=515&ltemID=18977.

Limited access to off-farm opportunities accounts for much of the cross-regional income differences, mirroring the spatial variation in the economic structure within the country. Average incomes are significantly lower in high mountain communes, especially in non-farm wages, household businesses, and remittances categories (figure 4.3). The combined income differential in *household businesses* and *wage earnings* alone almost explains the differences in income between high mountain and inland-delta communes. These differences are not only a result of limited participation in off-farm wage jobs, but also due to the much lower average wage earnings in remote areas, reflecting the low-value addition and opportunities in the lagging low and high mountain areas. Improved access to more productive off-farm opportunities is therefore key to closing Vietnam's spatial disparities in household incomes. In part, this requires overcoming the challenges of remoteness that characterize many of the lagging areas, making improved connectivity a central pillar for equalizing access to opportunities in Vietnam.

FIGURE 4.3. **Regional Comparison of Average Incomes in 2016**



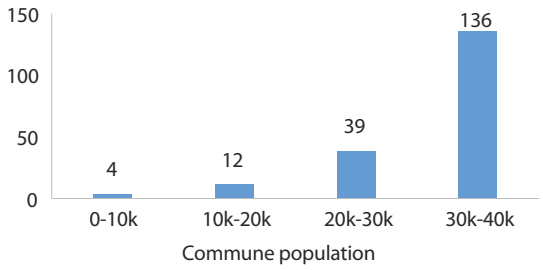
Source: World Bank estimates from 2016 VHLSS, conducted by the GSO. See: https://www.gso.gov.vn/default_en.aspx?tabid=515&ItemID=18977.

Conceptual Link between Connectivity and Economic Outcomes

At the macro level, uneven distribution of densities is a natural outcome of geography and economic agglomeration. Multiple factors explain the concentration of economic activities in some locations, including the geography of the country, the gains from agglomeration, the access to international gateways, and so on. While workers benefit from concentration through better access to jobs and amenities, and firms benefit from access to production services, consumers, and workers, such concentration also brings pollution, congestion, and higher land prices, which can in turn discourage or constrain further concentration. The relative strengths of the agglomeration and dispersion forces underlying these concentrations of economic activity are central to spatial disparity and other related economic issues.

Firm location and investment decisions strongly correlate with economic density and connectivity, which in turn determine availability of wage jobs. Data from the 2016 economic census show fewer firms in remote areas. Two-thirds of communes without an enterprise in 2016 are located in mountainous areas. The smaller market means fewer opportunities for easy-to-start household enterprises, most of which concentrate in the retail and trade services sectors. An average of four service sector enterprises operate in communes with fewer than 10,000 people, compared to an average of 136 such enterprises in communes of 30,000 to 40,000 people (figure 4.4), which shows the potential

FIGURE 4.4. **Number of Service Sector Enterprises by Commune Population in 2016**

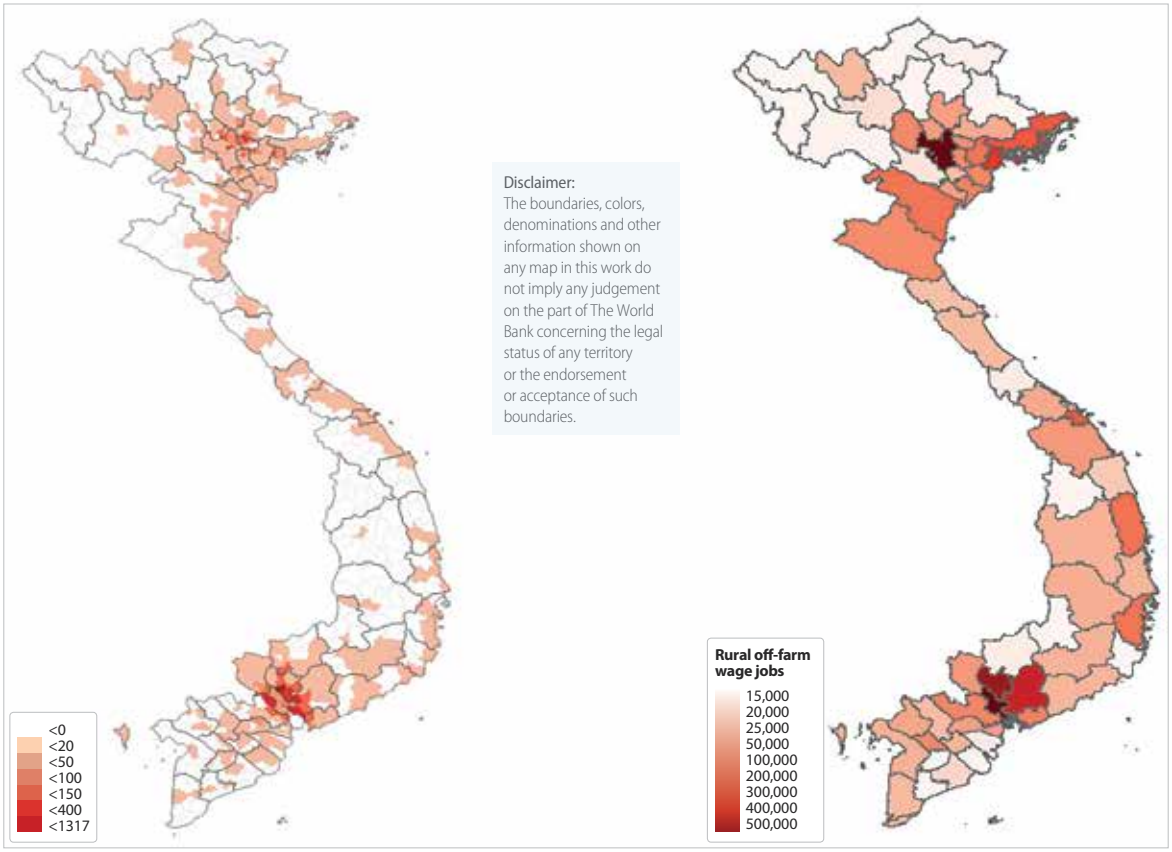


Source: World Bank estimates from 2016 VHLSS, conducted by the GSO. See: https://www.gso.gov.vn/default_en.aspx?tabid=515&ItemID=18977.

high-density multiplier effects that makes growth in more populated areas much more organic than in sparsely populated areas. The average firm is also smaller in less populated communes, averaging 16 workers per firm in communes with fewer than 10,000 people, and about 36 workers per firm in communes with between 30,000 and 40,000 people. Similarly, foreign direct investment (FDI) in Vietnam is largely concentrated in high density population areas (see figure 4.5). However, some less populated provinces with better market access due to good connectivity or proximity to international gateways (for example, China in the north) have become incipient recipients of FDI. As a result, far fewer wage jobs are available in remote areas (figure 4.6).

FIGURE 4.5. **Spatial Distribution of Foreign Direct Investment in Mainland Vietnam in 2016**

FIGURE 4.6. **Spatial Distribution of Wage jobs in Mainland Vietnam in 2016**



Source: World Bank estimation based on the 2017 Economic Census conducted by the GSO. See: https://www.gso.gov.vn/default_en.aspx?tabid=515&idmid=5&ItemID=19083.

Remoteness and low density contribute to the lack of economic opportunities in Vietnam's lagging areas. Structurally, the lagging areas of Vietnam—further away from economic hubs, yet much more sparsely populated—have low market access. By reducing local potential for job creation and/or reducing household incentives to participate in off-farm activities, the low market access can in turn be a limiting factor to households' access to better jobs. Lacking the internal growth factors that come from large network effects and links in large urban areas, remote and low-density

economies are characterized by the following patterns: First, the economic activities tend to be based on absolute local advantages, such as land, forests, and ecological and cultural attractions. Examples in Vietnam include forestry products and ecotourism in the northern mountain regions. Second, with small local markets, growth in economic activities is driven by external demand, either domestic (from cities and other regions), and/or international, for example, in niche products and services or tourism. Third, growth is mostly delivered by small and medium enterprises (SMEs), since it is often difficult to achieve scale in low-density economies, except for single-firm localities dominated by one large firm that exploits the area's natural resources, as in the case of mining. Both low labor supply and low local demand due to small population size can limit scale in this case.

Connectivity is key to both maximizing the benefits of agglomeration and overcoming the challenges of remoteness and low density by reducing economic distances between firms, people, and markets. Transport connectivity is central to understanding how people and firms locate across space and defines how regions can access other domestic and global markets. Better connectivity will reduce frictions hampering growth and improves access for lagging regions to the rest of the country and global markets. Given the above spatial distribution of people and economic activities in Vietnam, the transport network quality will matter in connecting the main growth poles, in connecting the secondary cities to these main growth poles, in connecting lagging regions to growing regions, and in connecting these regions to the main international gateways. Thus, development strategies for low-density economies depend on improved connectivity to link them into the network economy, thus enlarging the external market crucial for generating growth in low-density economies.

With better connectivity and market access, lagging areas could tap into regional and global value chains by attracting maturing industries seeking cost advantages beyond large urban centers. As agglomeration centers evolve into high-value products, some mature industries lose their competitiveness in large urban areas. They then seek to relocate to the periphery, with cheaper labor, rents, and other services. This provides an opportunity for growth in lagging areas, but one that would most likely benefit areas with better connectivity and market access. The shift of garment value chains and other low value-added manufacturing activities have also been biased toward outer provinces with much better access.

Besides limiting job creation and thus labor demand, remoteness also creates stronger incentives for households to prioritize food subsistence over non-food production activities (Low 1986). Remote and therefore poorly integrated food markets create a price wedge. Isolated households tend to pay more for food from outside markets because of the high transaction costs. Thus, households in remote areas will have a strong incentive to produce food, at a lower cost, to meet their own consumption requirements. Conversely, any surplus they produce would fetch a low producer price because of the same high costs of marketing the crop outside the area. The result is a low-level subsistence equilibrium, biased toward food production. This affects household labor supply decisions at two levels: (a) crop choice when allocating land among different agriculture activities, and (b) participation rates in off-farm activities when allocating labor. Within agriculture, the price wedge would disincentivize a shift of production to higher-value non-cereal crops, even in areas more agronomically suitable for non-cereals crops. When it comes to off-farm participation, the price wedge reduces off-farm participation in disconnected markets, until people meet their subsistence

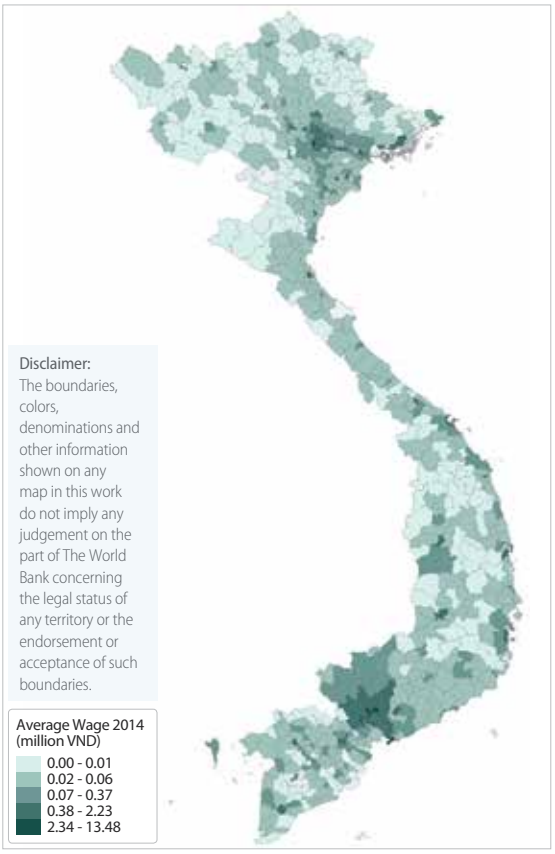
food needs, which then naturally increases the off-farm labor supply. Thus, low market access can be a limiting factor to off-farm participation by both reducing labor demand and off-farm labor supply.

In addition to the impact of access to wage jobs, market access can also explain the variation in real wages across regions. In literature, the regional variation in wages has been attributed to (a) skills sorting, arguing that agglomeration centers attract better-skilled and better-paid workers, (b) increasing returns—external to firms, due to spillovers between firms or human capital externalities, as agglomeration generates greater knowledge spillovers between firms and workers, therefore raising productivity and wages, and (c) non-human factor endowments (Combes, Duranton, and Gobillon 2008; Hanson 2003; Head and Mayer 2006). However, a growing body of literature appeals mainly to transport costs and increasing returns (Redding and Venables 2003; Redding and Venables 2004), arguing that market access accounts in part for the spatial variation in wages across regions. Firms in locations with greater market access face lower transportation costs, which increases their profitability and ability to pay higher wages while remaining competitive. Invoking this argument, Hering and Poncet (2010) finds market access explains a significant part of the interindividual difference in wages in China—after controlling for skills, living costs, firm types, and provincial fixed effects accounting for other place-specific, non-human endowments present in agglomeration centers with higher market access.

A large variation in wages is also evident in Vietnam (figure 4.7). Lagging provinces, with lower market access, have significantly lower average wages. Average wages are highest in densely populated areas around the Hanoi–Haiphong and HCMC economic corridors. Wages are substantially lower in less populated areas further off these economic corridors or international gateways, thus providing a positive correlation between market access and wages.

The remainder of the chapter sets out a framework for an empirical analysis to verify the above conceptual link between connectivity and economic outcomes.

FIGURE 4.7. **Spatial Variation in Average Wage Jobs in Vietnam**

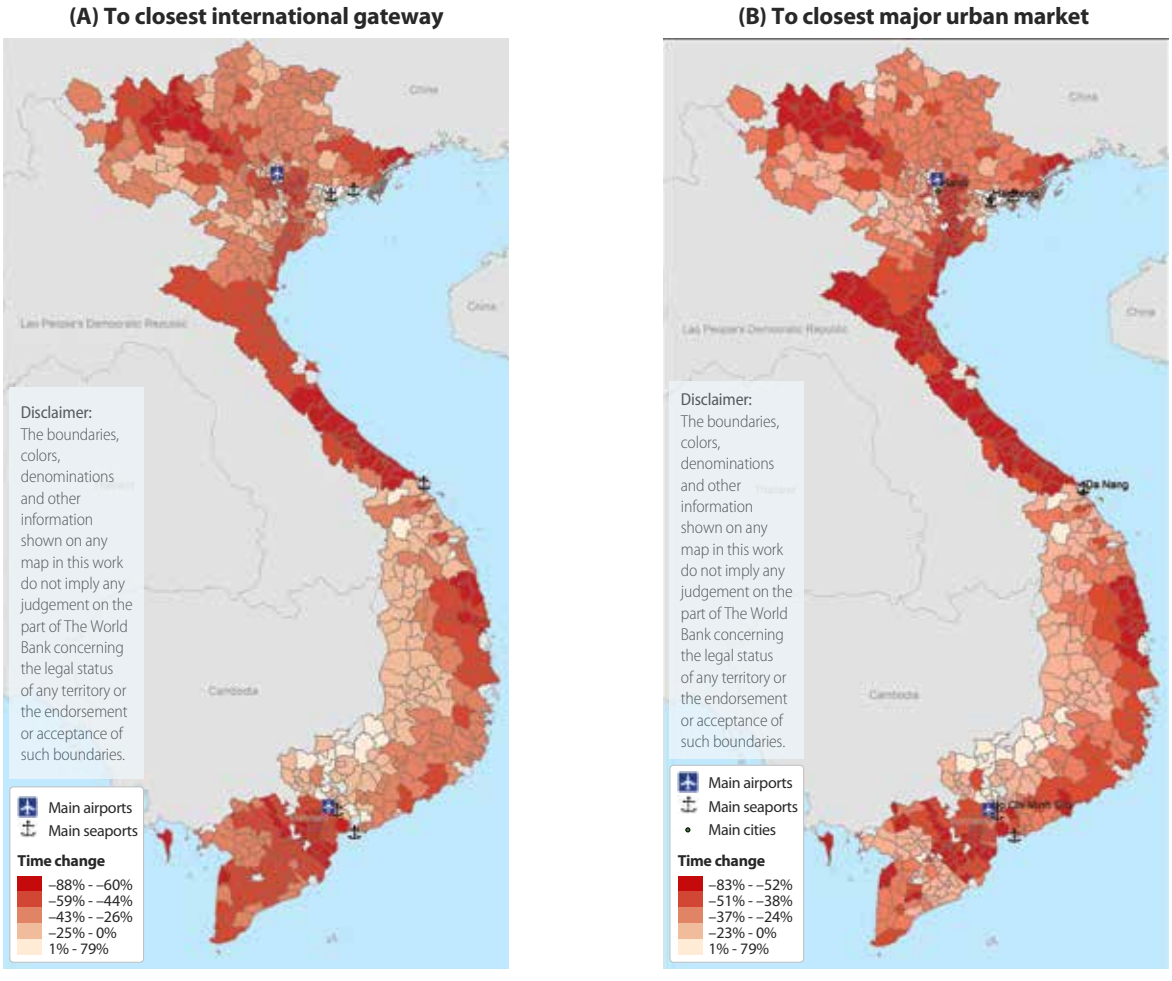


Source: World Bank estimates based on the 2017 Economic Census conducted by the GSO. See: https://www.gso.gov.vn/default_en.aspx?tabid=515&idmid=5&ItemID=19083.

Changes in Connectivity and Spatial Development in Vietnam

During the last decade, travel time and transport costs from most localities of Vietnam to major urban areas and international gateways have both seen reductions, thanks to expansion of the transport network and improvement of road conditions. Using the transport network of the two time points (2009 and 2017) depicted in figure 1.5, travel time was calculated from each district to its closest major city and international gateway.[1] As shown in figure 4.8, travel time has improved significantly for districts in the center, north of Da Nang, on the Hanoi–Lao Cai corridor toward China, and south of HCMC. On average, travel time to the closest main city has decreased by 33 percent between 2009 and 2017, and travel time to the closest gateway by 38 percent.

FIGURE 4.8. **Changes in Travel Time to Major Markets in Mainland Vietnam from 2009 to 2017**



Source: World Bank calculations and mapping using the transport network and population data provided by various Government of Vietnam sources.

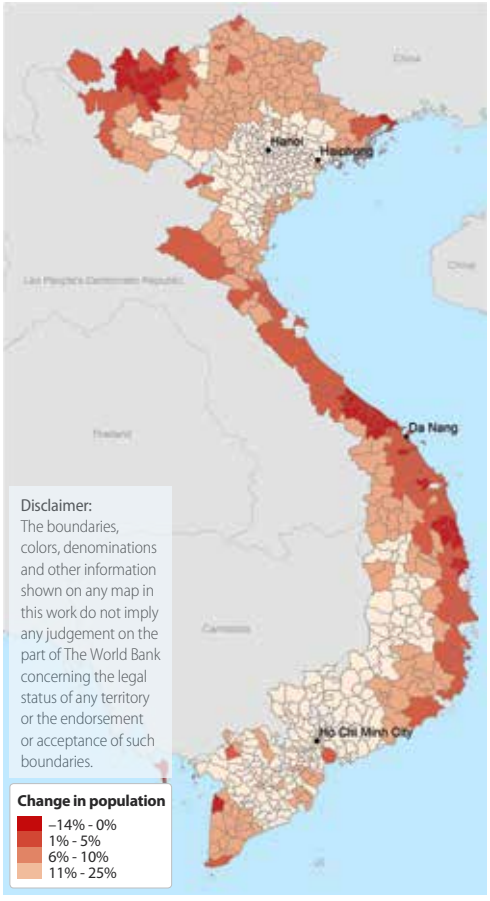
However, changes in travel time have been highly uneven across the country, with burgeoning congestion contributing to deteriorating connectivity in some districts. While for most districts improvement of transport has generally resulted in substantial reductions in travel time to the nearest

international gateway, the negative impact of congestion has been observed in others. Particularly in the districts closest to the main two ports of Haiphong and HCMC, increasing congestion has led to lower speeds and higher times to reach the sea or air ports; some districts experienced a doubling of travel time.

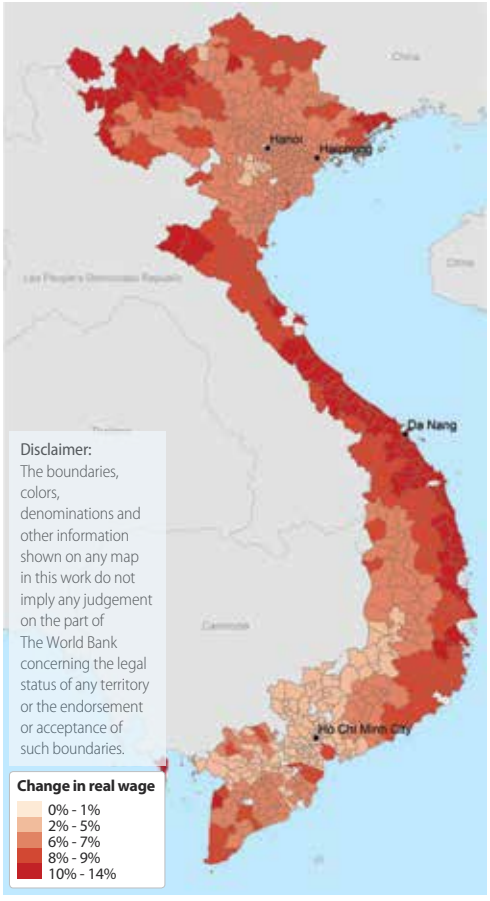
During the period between 2009 and 2017, improvements in connectivity alone have raised national welfare and real incomes for all communes.[2] By modeling a counterfactual, whereby no transport improvement would have taken place since 2009, we estimated the impacts of connectivity improvement on the income and welfare at the commune level, with transport investments between 2009 and 2017 contributing to the national real income of 6.7 percent. In other words, without the improvements in connectivity, keeping all other factors constant the real income of the country would have been 6.7 percent lower. While incomes in all localities have improved due to better connectivity, such outcomes were unevenly distributed across districts, with an income growth of only 1.1 percent in the district that benefited least from transport investment (Co To district, Quang Ninh province) and a growth of 14.5 percent in the district that benefited most from it (An Minh district, Kien Giang province). Lower transport costs to reach districts in the rest of the country reduces consumption prices and attract more workers in locations with better market access. Figure 4.9 shows the simulated effects of the network changes between 2009 and 2017 on population and wages.

FIGURE 4.9. **Simulated Effects of Connectivity Improvement between 2009 and 2017**

(A) On population



(B) On wages



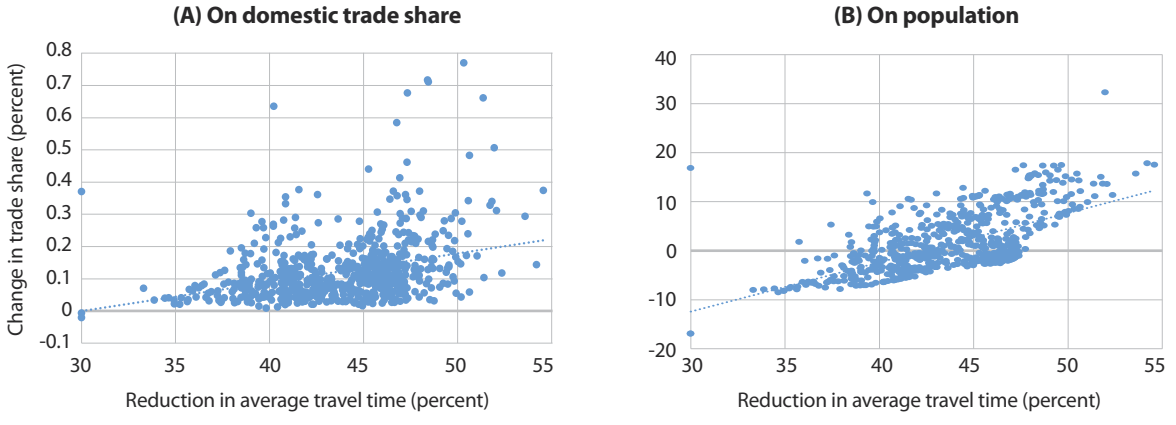
Source: World Bank calculations and mapping using the transport network and population data provided by various Government of Vietnam sources.

Welfare benefits stem from increases in domestic trade within the country due to reduction in travel time. Better connectivity results in cheaper access to consumers and producers in other districts and increases domestic trade (figure 4.10A). The districts that experienced the largest reductions in average domestic travel time saw the highest increase in trade with other districts. When consumers have access to more and cheaper goods from the rest of the country, producers can sell to more consumers.

The connectivity improvement from 2009 to 2017 has slowed down the concentration rate of workers in the main two urban poles, benefiting more distant areas in the northwest and along the coastline. This happened because improvements to the transport network occurred in a relatively even fashion across the country, with significant investments made in some less-developed and lower-density areas. By reducing travel time and improving market access for some less-dense and less-rich areas, changes in the transport network brought large increases in real wages and attractiveness of these areas for workers. As a result, population growth in the districts around Hanoi and HCMC slowed to a lower growth rate. While better connectivity has increased real incomes for all districts, wages have grown faster in the Northwestern and Central Highlands districts of the country (figure 4.9B). While the creation of better opportunities in these districts has slowed down domestic migration toward the two main urban centers, migration to these centers remains the dominant form of rural-urban migration for the country (figure 4.9A). The overall effects on territorial development are mixed, however, leaving isolated areas that virtually lost out on the growth and dynamic centers that benefited.

The movement of people and economic activities within the country can explain the uneven benefits and how some regions experienced a relative loss from better connectivity. Workers reallocate toward the districts offering the highest opportunities that come from the increasing economic activities due to better market access. Some districts become more attractive and grow while others might lose population or grow very little. Overall, the districts that experienced the smallest connectivity improvements did not attract more workers from other regions and instead tended to lose population over time (figure 4.10B).

FIGURE 4.10. **Simulated Effects of Connectivity Improvement between 2009 and 2017**



Note: Each dot represents one commune.

Connectivity and market access

Impacts of connectivity on spatial economic development are better understood through a market access index, a composite indicator that aggregates economic distances to all possible economic densities. A market access index captures transport costs between consumption and production locations in all potential trading districts (see box 4.1 for the definition). Reducing transport costs on one segment affects locations directly on the segment as well as locations through which producers or consumers travel. Market access can be used to quantify the connectivity of districts to other domestic markets; therefore, transport investments will affect market access of all locations.

Box 4.1. Measuring Market Access

Expansion of the transport network affects all communes, either directly or indirectly. The total impact on each district can be captured by changes in that commune's market access. Market access depends on the quality of the transport network and the size of markets connecting to acommune.

Following Donaldson and Hornbeck (2016), market access can be approximated by the following expression:

$$MA_o \equiv \sum_d \tau_{od}^{-\theta} N_d$$

With MA_o the market access index at the commune "o," τ_{od} the trade cost between two communes, "o" and "d," N_d is the population of commune "d," and θ is the "trade elasticity."[3]

Trade costs between the two districts, τ_{od}, are defined by $\tau_{od}=\exp(\lambda\, time_{od})$ with $\lambda=0.02$ and $time_{od}$ the optimal travel time between the population center of the two communes using the transport networks of 2009 and 2017.[4]

Source: Sheffi 2012; Lynch 2013.

Market access is significantly greater for communes around Hanoi and Ho Chi Minh City, and has improved for all communes between 2009 and 2017, as depicted in figures 4.11A and 4.11B. In 2009, market access index for communes in or very close to Hanoi and HCMC sat just above 2.0 and increased to more than 2.5 in 2017. The communes in and around the cities and their respective ports have the best access to domestic markets. Over the period, the average market access index grew from 1.31 to 2.20, an increase of 88 percent over nearly 10 years. Comparison between the two time points highlights the positive impacts of the agglomeration and development of major transport infrastructure, such as several expressways.[5] Compared to 2009, current access to markets remains higher around the main two cities, but has also improved in their larger peripheries. Accessibility has also improved greatly for communes along the coast line as well as along the major transport corridors where investments have been made.

Changes in market access mostly result from changes in transport costs over the last decade. Access to markets depends both on transport costs and the size of the markets that can be reached. Thus, the improvement of market access can be attributed to growing population in

neighborhood communes as well as to improvements in the transport network. Disaggregating the change in market access between 2009 and 2017 shows an average 79 percent change in market access due to changes in transport costs, with an average 5 percent change in market access due to population shifts, as illustrated in figures 4.11C and 4.11D.

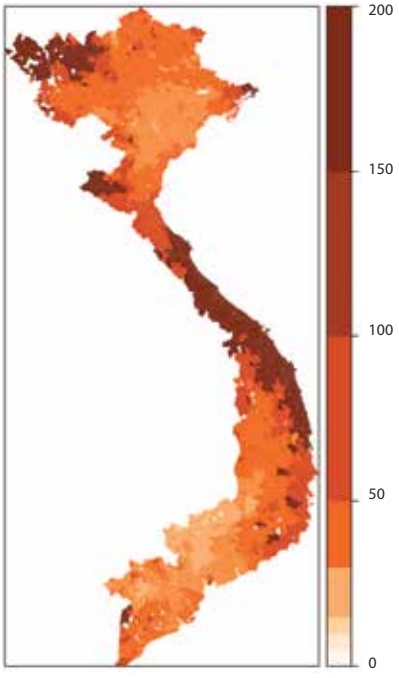
FIGURE 4.11: **Market Access Index for Communes in Mainland Vietnam**

(A) In 2009

(B) In 2017

Disclaimer:
The boundaries, colors, denominations and other information shown on any map in this work do not imply any judgement on the part of The World Bank concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

(C) Changes in market access due to transport costs



(D) Changes in market access due to population

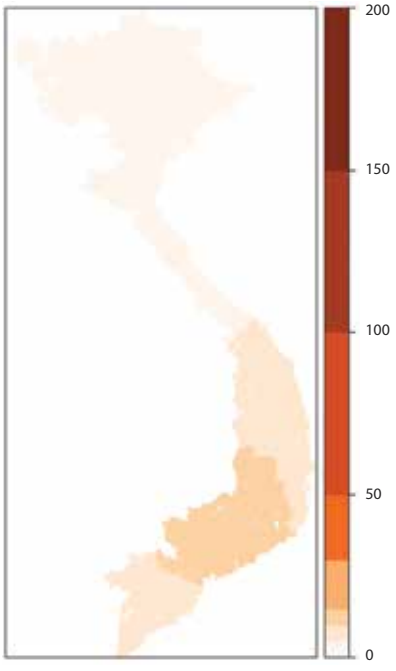


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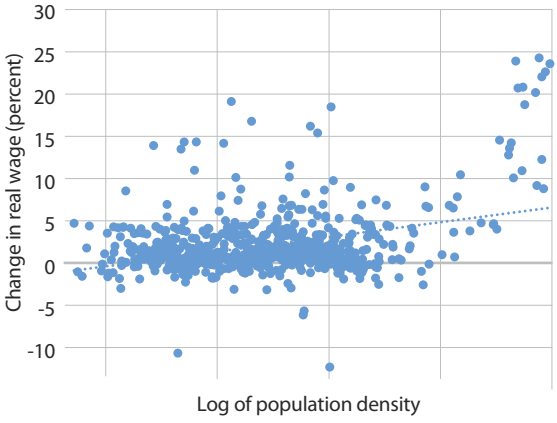
FIGURE 4.12. **Spatial Gains from Investments between 2009 and 2017**



While changes along the transport network benefited central and northeastern communes, population changes increased market access for the southern communes. Transport network improvements have mainly benefited communes along the coast between Vinh and Qui Nhon, and isolated communes in the northeast at the border with Lao PDR and China. The northeastern communes were previously isolated with very poor access to the rest of the country and have largely benefited from transport improvements to connect to more distant markets. Demographic changes have benefited communes in the south, around Ho Chi Minh city, as growth in market access due to population exceeds 8 percent for the southern communes. Over the past decade, gains from the improving transport network have disproportionately benefited the most dense districts, for example, urban centers (figure 4.12).

Improvements in transport infrastructure have expanded market access, which in turn increases wage and attracts more population. Keeping population fixed between 2009 and 2017, communes where market access expanded from the improved conditions on the transport network had relatively higher wages and higher population (see box 4.2 for the methodology). On average, a 1 percent increase in market access associates to a 1.23 percent wage increase and a 0.09 percent growth in commune population. Expansion of a commune's access to more populated communes positively correlates with a higher average wage and higher population density in the commune (table 4.2A). Improved connectivity—but assuming no changes in population—also positively links to better wages and higher population density. On average, a 1 percent increase in market access associates to a 8.25 percent wage increase and a 1.15 percent growth in commune population (table 4.2B).

Box 4.2. Correlations between Market Access, Wage, and Population

Following the economic literature, better market access leads to higher wages and attracts more population across communes. Using GSO census data on wage and population at the commune level for two years, a log-log regression using fixed effect at the commune level delivers the elasticity of market access with respect to wage (ϵ^w) and to population (ϵ^p).

$$\log\log(\text{wage}_{\{c,t\}}) = \alpha + \epsilon^w \log\log(\text{Market Access}_{\{c,t\}}) + u_c$$

$$\log\log(\text{population}_{\{c,t\}}) = \alpha + \epsilon^p \log\log(\text{Market Access}_{\{c,t\}}) + u_c$$

Legend: "c" = commune; "t" = the year; "Market Access" = the index computed.

TABLE 4.2. **Result of Regression of Market Access on Commune's Average Wage and Population**

Variable	(A) Market Access (total)		(B) Market Access (from transport)	
	Wage	Population	Wage	Population
Log Market Access	1.23***	0.09***	8.25***	1.15***
	(128.6)	(221.1)	(113.9)	(490.4)
Constant	1.46***	9.05***	−1.31***	8.63***
	(214.4)	(32456.7)	(−41.7)	(8949.2)
Fixed effect	Yes	Yes	Yes	Yes
Observations	440,522	398,866	440,522	398,866
R-squared	0.070	0.197	0.056	0.547

Note: t = statistics in parentheses; ** = p<0.01; *** = p<0.001.
The results can be interpreted as elasticities associated with an improvement of a 1% of the Market Access Index for two types of Market Access. The first two columns report results for a measure of market access considering both changes in transport costs and population distribution. The last two columns also consider the impact of changes in transport costs on the market access index.

Empirical Relationship between Market Access and Economic Outcomes

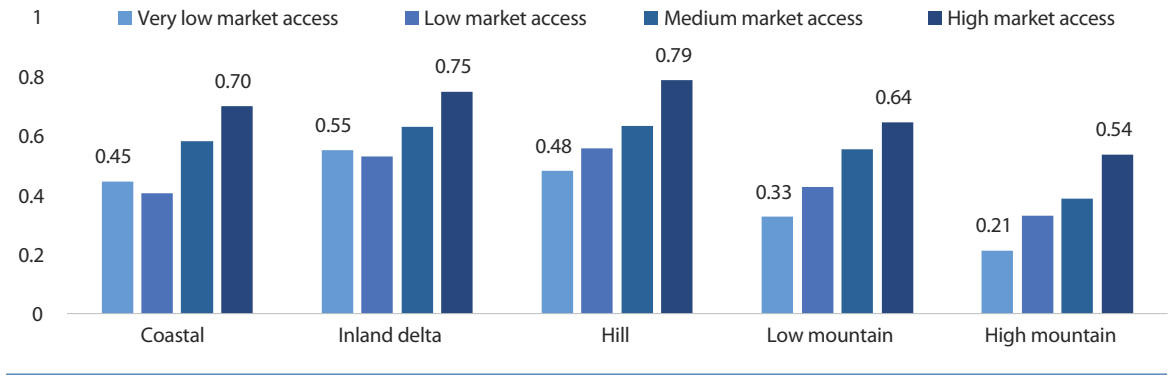
How is market access correlated with economic outcomes at commune and individual household levels? The discussions in this and the following sections present the key findings from quantitative and econometric analysis (see *appendix A* for a detailed description of the methodology). The below analysis focuses on the relationships between (a) market access and household access to off-farm jobs and (b) market access and wages.

Descriptive evidence suggests a strong correlation between market access and access to off-farm opportunities in Vietnam. As expected, market access is highest in the HCMC and Hanoi–Haiphong corridors, where the highest concentration in access to off-farm jobs is observed. In the northern mountain provinces, access to off-farm jobs is significantly better in Lao Cai, Yen Ban, and Phu To provinces (figure 4.13). Located along the Hanoi–Lao Cai Expressway, these provinces have far better market access indicators compared to surrounding provinces. Contrast this to provinces like Dien Bien which are poorly connected and have the lowest number of off-farm wage jobs—at fewer than 15,000 per province. However, descriptive evidence alone is not conclusive due to the presence of confounding factors. Areas with low market access tend to coincide with those populated by an ethnic minority or with lower education attainment, which have been found as important factors (Hoang, Pham, and Ulubaşoğlu 2014; Newman and Kinghan 2015). Road infrastructure investments are also endogenous to economic potential across areas. A tendency to build roads in areas with high economic potential increases the likelihood of more job creation. The following analysis attempts to isolate and quantify the contributions of market access to household participation in non-agriculture employment activities in rural and peri-urban areas, controlling for the confounding factors.

The result suggests that market access explains a considerable amount, but not all, of the variation in access to off-farm opportunities in lagging areas. Improved market access also mitigates the disadvantage of low population density. Even after controlling for other factors, the local population density accounts for a significant variation in the probability of holding off-farm wage employment. But households living in a low-density population area with market access have far better prospects for a higher-wage job. In high mountain communes for example, the probability of off-farm wage employment nearly doubles for both the lowest and middle densely populated communes as market access improves from less than one standard deviation below the mean, to within a standard deviation above the mean. In low mountain communes, a 48 percent (15 percentage points) increase is observed for the low-density population communes, but only marginal changes in the medium-density population communes. This pattern suggests that improvements in market access make a larger difference to job access in the remotest and least populated communes than anywhere else.

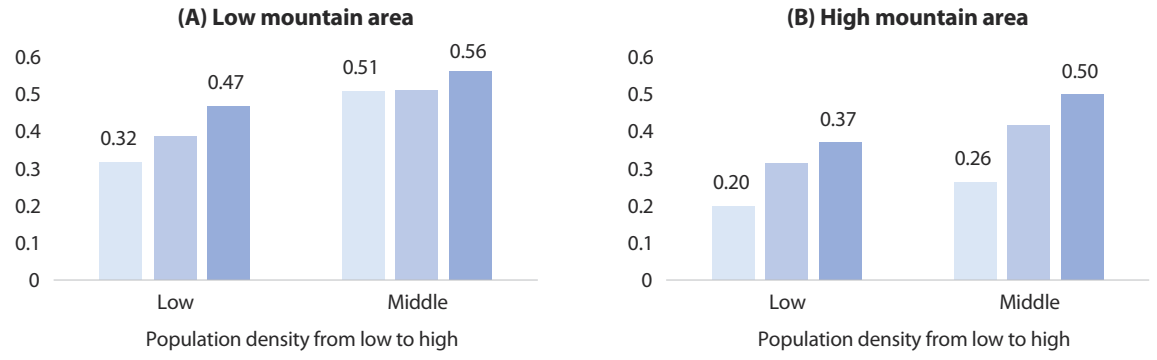
Figure 4.14 shows the estimated probability of holding an off-farm wage job at different levels of market access across communes, for young men between 20 and 30 years old, with lower secondary education from the Kinh ethnic group in a rice farming household. In a high mountain commune, that person's prospects of being employed in an off-farm wage job increases from 21 percent among those with the lowest level of market access to 54 percent among those with the highest market access. A 31 percentage-point increase (close to double) is observed in low mountain areas as well. A 20 to 33 percentage-point increase is observed across all types of communes as market access expands from the lowest to highest market access classification category. The greatest change occurs in communes with more difficult terrain.

FIGURE 4.13. **Probability of Off-Farm Job Participation by Topography and Market Access**



Note: Predicted for a Kinh male aged between 20 and 40 years with lower secondary, from a farming household and living in a commune with median population density and a firm present. Market access is categorized into four groups based on their standard deviation from the national average: **Very low** – 2 to 1 std. dev. below mean; **Low** – 1 to 0 std. dev. below mean; **Medium** – 0 to 1 std. dev. above mean; and **High** – 1 to 2 std. dev. above mean.

FIGURE 4.14. **Probability of Off-Farm Job Participation by Topography, Population Density and Market Access**



Note: Predicted for a Kinh male aged between 20 and 40 years with lower secondary, from a farming household, and living in a commune with a firm present. Regression controls for the local population density separately from market access calculated using only population and time travel to other communes. The classification of communes into low and medium population density is based on terciles of the national population density. In this graph, market access is categorized into three groups based on their deviation from the national average: **Very low** – 2 to 1 std. dev. below mean; **Low** – 1 to 0 std. dev. below mean; **Medium** – 0 to 1 std. dev. above mean.

Differences in market access accounts for a better proportion of differences in access to wage jobs between places, than between ethnic groups. Statistical decompositions[6] suggest that differences in observable characteristics such as market access, education, farming system, and demographic profile, together account for around 94 percent of the differences in access to wage jobs between inland and delta communes and other communes. About 31 percent of this explained difference—or 29 percent of the overall difference—is due to poorer market access outside inland and delta communes (table 4.3). However, gaps in observable characteristics only account for 63 percent of the differences in wage job prospects between ethnic minorities and the majority, of which market access accounts for 34 percent of this explained difference—or 22 percent of the overall gap. A key difference, when comparing gaps in access to off-farm wage jobs between places rather than between ethnic groups, is that minorities seem not to benefit as much from their supposed demographic advantage of having more young people, who generally have the brightest job prospects in Vietnam. This demographic advantage is lower when only comparing locations, *meaning that while investment to improve market access can help close the gap in access to off-farm wage jobs between lagging regions and other places, complementary policies are needed to improve access to jobs for ethnic minorities within regions, allowing them to benefit despite their demographic advantage.*

TABLE 4.3. **Decomposition of Access to Off-Farm Wage Jobs**

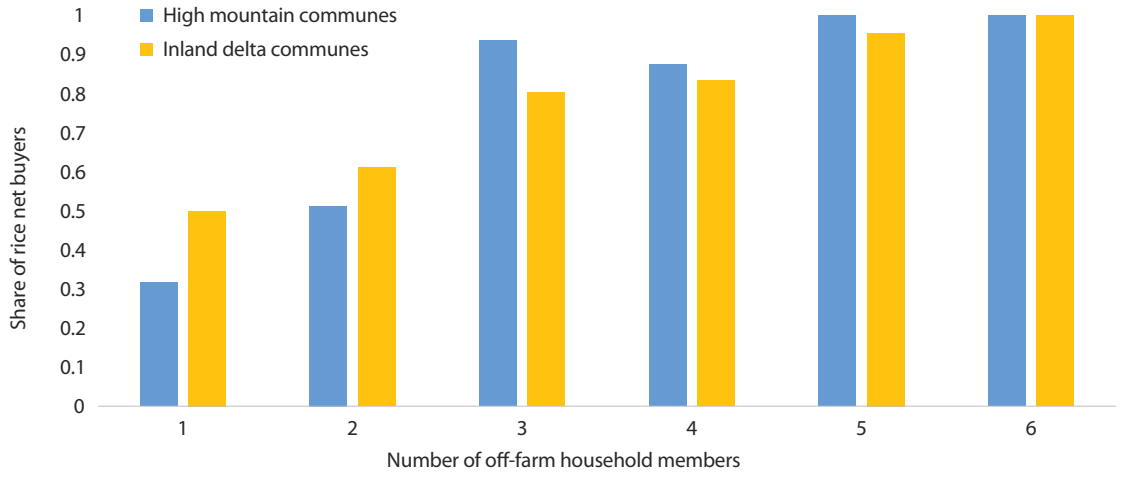
	Ethnic minorities vs Kinh & Hoa		Inland/delta vs other communes	
Difference	0.185		−0.143	
Explained gap	0.117	100%	−0.135	100%
Demographic composition	−0.035	−30%	0.018	−13%
Education attainment	0.010	8%	−0.007	5%
Farm characteristics				
Farm activity type	0.008	7%	−0.013	10%
Agricultural prices	−0.002	−2%	0.002	−1%
Agric wages relative to non-agriculture wages	0.004	4%	−0.003	2%
Local economic potential				
Market access	0.040	34%	−0.042	31%
Population density	0.067	57%	−0.064	48%
Road in commune	0.000	0%	0.002	−2%
Residual location differences	0.018	15%	.	.

Source: World Bank calculations from the 2016 VHLSS, conducted by the GSO. See: https://www.gso.gov.vn/default_en.aspx?tabid=515&ItemID=18977.
Note: . = not applicable.

Estimates suggest that improved market access can narrow the gender gap in wage job participation. The marginal effects of market access are significantly higher for spouses than for their husbands. In the joint allocation decision model, applied only to a subsample of couples, for example, comparison of the marginal effects of market access on non-farm wage jobs participation is nearly twice as large for spouses than for their husbands. Women in Vietnam are twice as likely to engage in unpaid family work than men, while both our estimates and those in recent literature (Dang, Hiraga, and Nguyen 2019) suggests that women in households with young children are less likely to engage in paid work. That market access can explain a higher variation of wage participation for married women than for their husbands suggests that improving market access helps women access paid jobs more, which in turn could help close the gender gaps in participation in paid work.

The positive relationship between market access and wage job participation in Vietnam appears to be influenced more by the impact market access has on job access than by integration of food markets, as the price wedge hypothesis would predict. The price wedge hypothesis argues that due to poorly integrated food markets, households in remote areas will be disinclined to engage in off-farm wage jobs until after their subsistence needs are met; therefore, net rice buyers would devote a smaller share of their labor to off-farm wage employment than households meeting their subsistence needs. In fact, evidence in Vietnam suggests the opposite. We compared the share of net-rice buyers based on the number of household members engaged in off-farm work using the VHLSS 2016 data, which indicated the share of rice net-buyers is higher among households with many people engaged in non-farm work in remote highland communes. Similar results found with inland and delta communes (figure 4.15) contradict the notion that disintegrated food markets trap people in agriculture in remote areas. The pattern suggests the need to first meet subsistence needs does not constrain households from seeking off-farm employment. Rather, the low availability of opportunities serves as the limiting factor to household off-farm income generation.

FIGURE 4.15. **Comparison of Rice Net Buyers by Number of Off-Farm Household Members and Type of Commune**



Note: The discrete number of a household's members off farm is used in place of the share of a household's members for ease of presentation. The pattern is qualitatively the same when estimated using the share of household members working off farm.

However, market access does seem to impact land allocation within agriculture in favor of food production. Estimated land-use choice determinants in Vietnam (World Bank 2019) show remote households are more inclined to use a higher share of their land to grow rice and maize than perennial or industrial crops, even in areas where the land is more appropriate for perennial and industrial crops. Compared with the national average, households located approximately 15 km away (equivalent to two standard deviations) from an all-weather commune road devote 16 percent less land to industrial-crop production. The supply response of perennial and industrial crops to relative rice prices is also low, suggesting that while households prefer to diversify their livelihoods into non-farming activities, isolated households will prioritize agricultural activities toward food production. The result creates a low-level subsistence equilibrium, biased toward rice and cereals, which disincentivizes a production shift to higher-value and more agronomically suitable perennial crops.

Market access and wage variation

The positive correlation between market access and spatial wage variation in Vietnam is consistent with the hypothesis that firms in locations with higher market access pay lower transportation costs, which in turn allows them to pay higher wages. However, other potential alternative mechanisms rely on agglomeration economics to explain the observed impact of market access on wages. These alternative mechanisms include (a) potentially high cost of living in agglomeration centers inducing firms to raise nominal wages (Dekle and Eaton 1999), (b) increasing returns for firms due to spillovers between firms or human externalities (knowledge spillovers), and (c) skills sorting or non-human factor endowments (Combes, Duranton, and Gobillon 2008; Hanson 2003). To isolate the impact of market access via the transport cost mechanism in Vietnam, the spatial variation in individual hourly wages is analyzed, accounting for skills, local population density, the cost of living, occupation, industry of employment, and firm ownership type.

Empirical estimates from this analysis show a positive correlation between market access and individual wage variations in Vietnam, most significantly for foreign owned enterprise workers. A one standard deviation increase in market access associates with 11.5 percent higher hourly wages, after controlling for individual education and experience as well as job characteristics (occupation, industry, and provincial fixed effects). The estimate for employees in the domestic private sector is less robust, with wages increasing an estimated 3 percent (for a one standard deviation in market access) without accounting for provincial fixed effects, but show no increase when controlling for provincial fixed effects. However, public sector employees (including state-owned enterprise, or SOEs) are paid more when working in locations with poor market access, consistent with additional allowances for government employees in hard-to-reach areas. Thus, market access appears to account for the variation in wages, predominantly among the FDI sector.

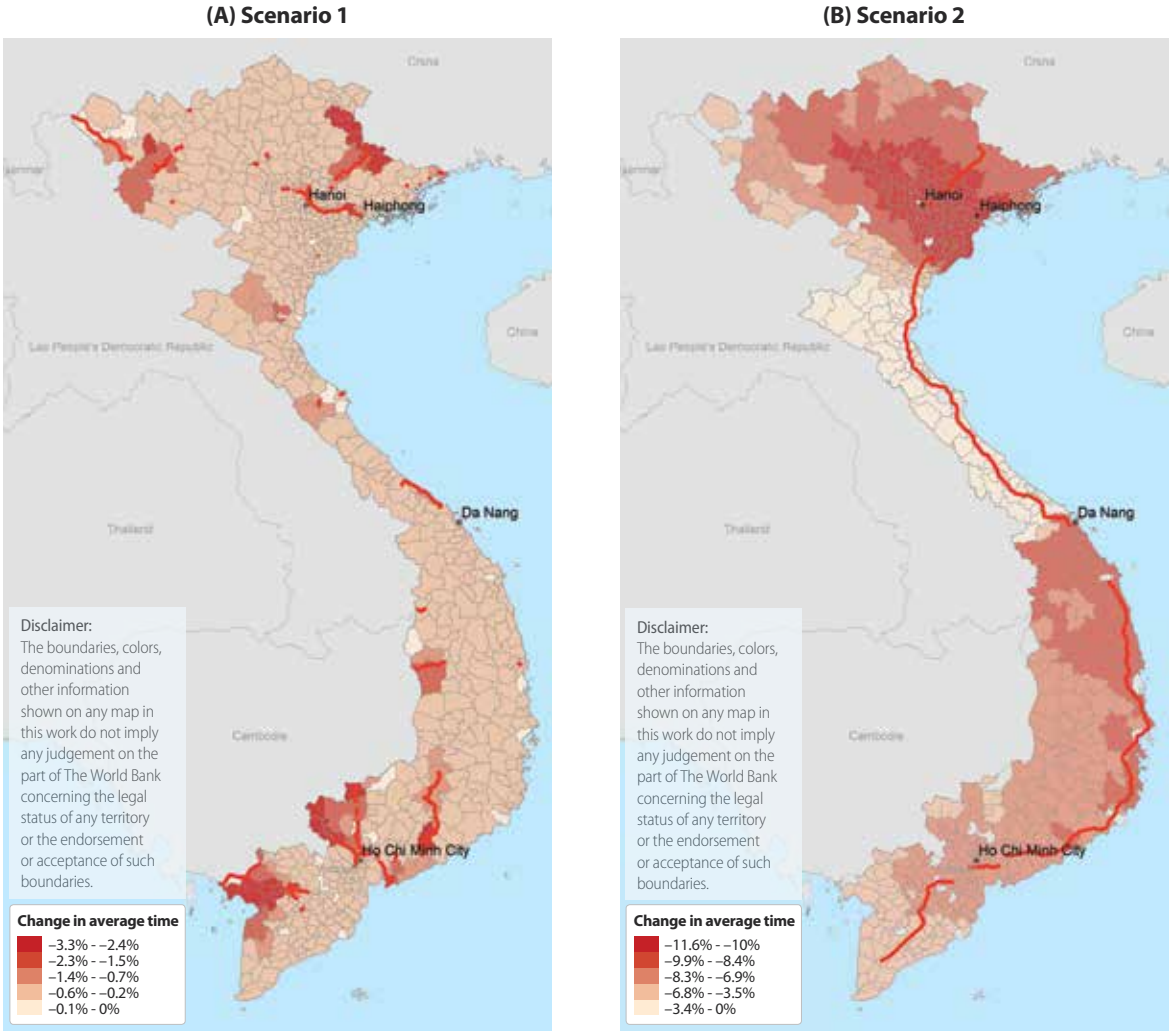
The evidence suggests other mechanisms linked to agglomeration significantly account for wage variation. That the impact of market access on domestic private sector wages is insignificant when controlling for provincial fixed effects suggests location specific non-human endowment factors contribute to the spatial variation in wages. The significance of the share of employees with post-secondary education points to the influence of skills sorting, while the significance of median housing values per square meter is consistent with Dekle and Eaton's postulation (1999) that a higher cost of living in agglomeration centers induces firms to pay higher nominal wages. These alternative mechanisms linked to agglomeration seem to explain more of the regional variation in wages when accounting for the possible influence of province, occupation, and industry.

Estimating Welfare Impacts of Connectivity Investment Scenarios

What level of welfare increases can we expect from the Government's investment strategy?

To support informed-decision making, we simulated the impacts of two high-priority programs in the Government's investment strategy for the transport sector: (a) Scenario 1—rehabilitation and upgrading of the national highway system focusing on connectivity to border gates, based on the Prime Minister's Decision 356/QĐ-TTg issued in 2013, and (b) Scenario 2—completion of the North–South Expressway from the northern Chinese border to the southern tip of Vietnam (Ca Mau). Analysis results show both future investment scenarios would bring about notable improvements in average travel time between districts, as depicted in figure 4.16.

FIGURE 4.16. **Simulated Travel-Time Changes of Future Transport Investment Scenarios**



Source: World Bank calculations based on data provided by the Government of Vietnam.
Note: The red lines indicate rehabilitated segments of the transport network.

The analysis shows that by reducing transport costs, future transport investments would improve the welfare of all districts and increase national income. Table 4.4 summarizes the analysis results. Under Scenario 1, future investments produce an estimated 0.13 percent increase in national income, with the growth rates at district level ranging from 0.02 percent (Co To district, Quang Ninh province) to 0.64 percent (Vung Tau district, Ba Ria-Vung Tau province). Under Scenario 2, the national income rise would be greater than under Scenario 1, at 0.65 percent, due to the steeper reduction in transport costs. Differences in the income growth rate at district level would be wider under Scenario 2: the lowest growth rate would be 0.11 percent (Co To district, Quang Ninh province) and highest would be 1.2 percent (Dai Loc district, Quang Nam province).

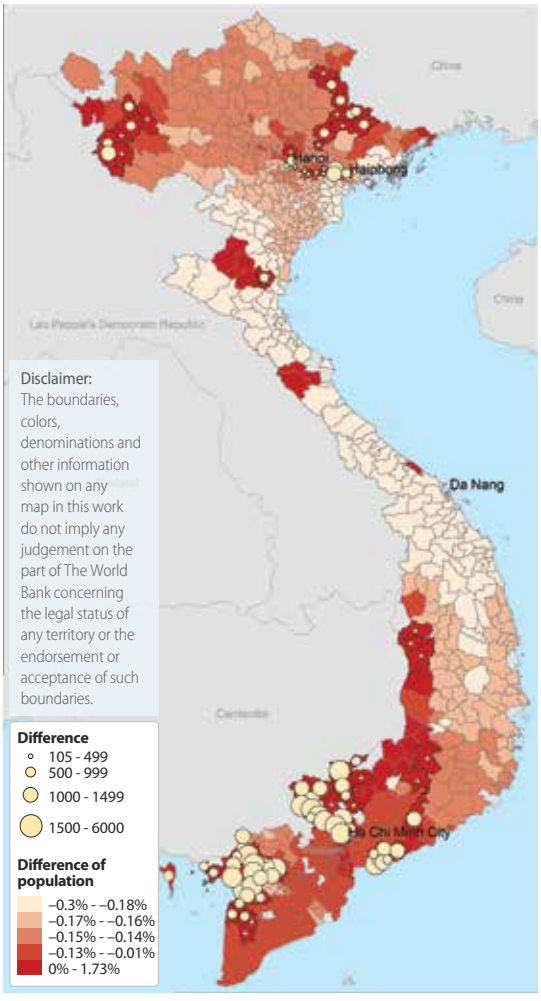
TABLE 4.4. **National Benefits and Spatial Differential Effects**

Benefits/Effects	Improvement 2009-17	Future scenario (1)	Future scenario (2)
Growth in national real incomes	6.7%	0.13%	0.65%
Lowest district-level growth rate	1.1%	0.02%	0.11%
Highest district-level growth rate	14.5%	0.64%	1.17%

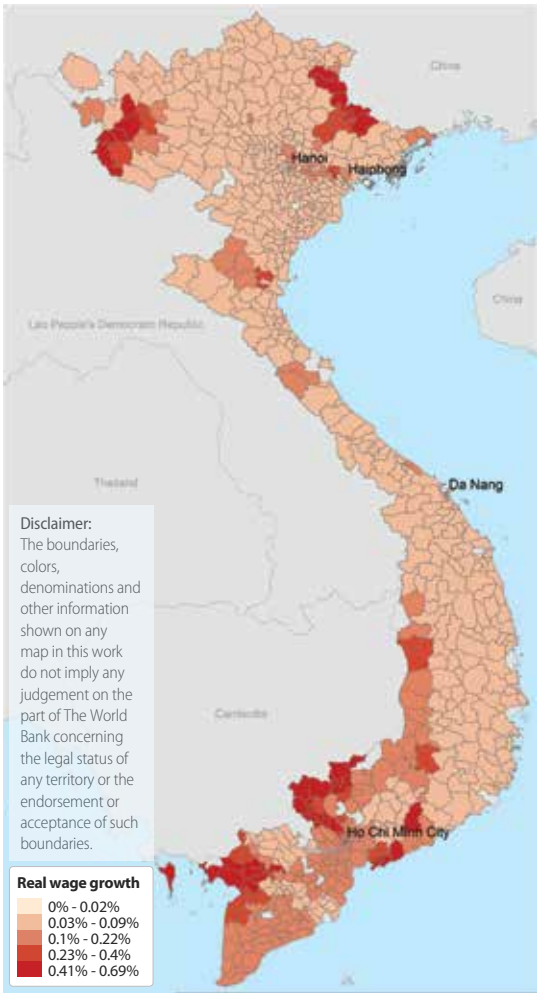
Transport improvements from Scenario 1 would benefit the northern and southern districts, with population and real income growth in the districts experiencing the largest reductions in transport costs. In general, this scenario would tend to benefit the richer, more populated, and less centrally located areas throughout Vietnam (figure 4.17). Richer regions will become more competitive and attract more workers. Keeping the same country population, a few districts around Hanoi, HCMC, and in some peripheral areas become more attractive for workers. In the north, transport investments would benefit the Hanoi–Hai Phong corridor. Additionally, a few districts along the borders would benefit from the largest reductions in transport costs, thus making them more attractive for workers.

FIGURE 4.17. **Simulated Effects of Future Transport Investment—Scenario 1**

(A) On population



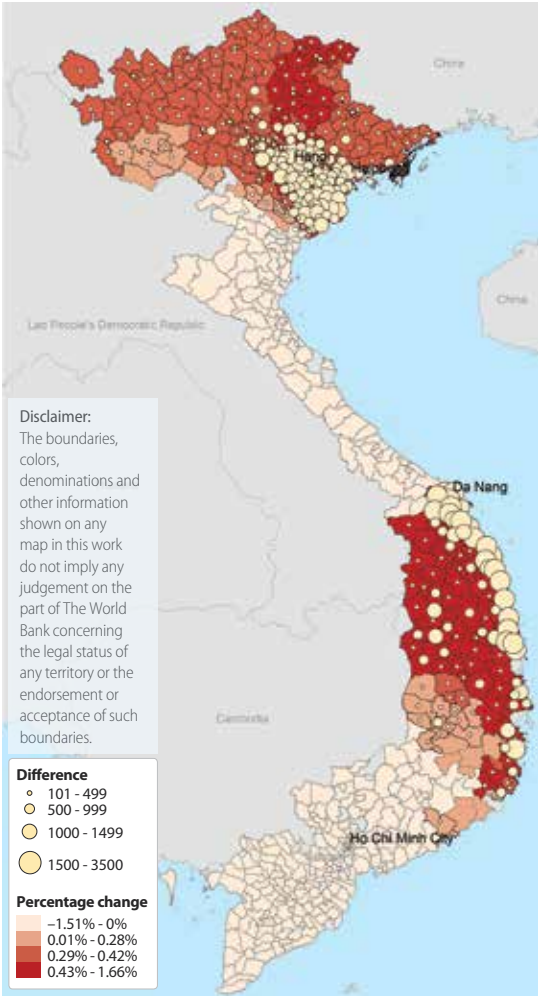
(B) On real wages



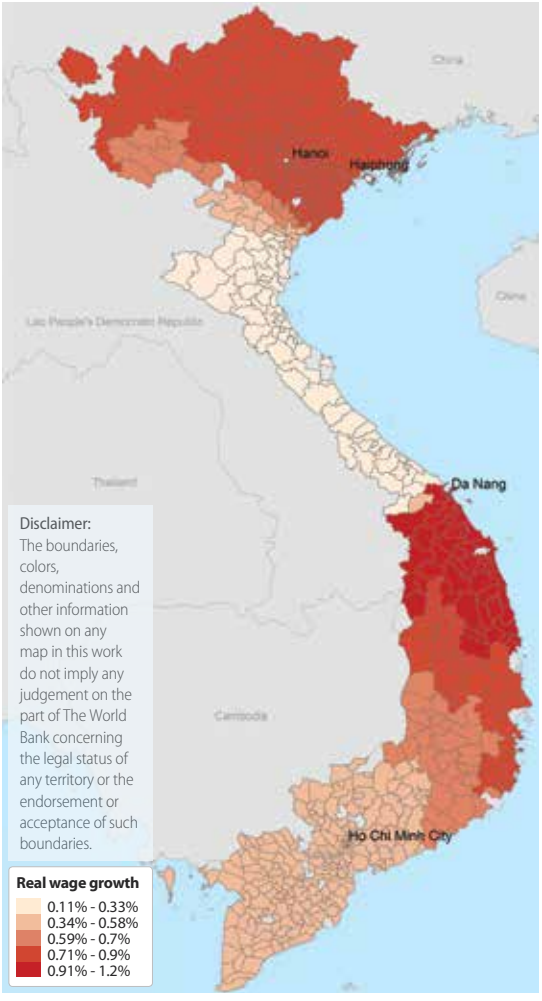
Transport improvements from Scenario 2 would benefit mostly the northern part of the country, including Hanoi and northern provinces, the coastal areas between Da Nang and Ho Chi Minh City, as well as some districts in the central highlands. In general, the investments under Scenario 2 would benefit poorer, less populated, and more centrally located areas in Vietnam (figure 4.18). Population and real income would grow in the districts with the largest reductions in transport costs. Northern districts and the central districts south of Da Nang would experience the largest increase in real wages. Keeping the same country population, the zone between Hanoi and the coast as well as the central coastal districts would become more attractive for workers. In contrast to Scenario 1, transport investments in Scenario 2 would not benefit the southern districts.

FIGURE 4.18. **Simulated Effects of Future Transport Investment—Scenario 2**

(A) On population



(B) On real wages



What level of income rises can we expect from connectivity improvement to international trade opportunities?

While the economic effects from domestic integration depend on access to other domestic locations, the spatial effects from international integration depend on the transport costs to the main gateways. As discussed in the chapter 2 section, "Performance and Efficiency of International Gateways," traded goods in Vietnam are primarily transported through the seaports and airports in Hanoi and HCMC, with less than 5 percent of all trade going through land borders. Based on 2016 trade flows, the analysis identified the following main gateways: Noi Bai airport, Haiphong seaport, Tan Son Nhat airport, Huu Nghi Lang Son (land border), Vung Tau seaport, Tien Sa seaport, and Cai Lan (land border). The two land borders lie along the land routes toward Kunming and Nanking in China.

Better integration with global markets, resulting from lower transport costs to reach international gateways, increases income and welfare through cheaper access to import and more competitive export. Over the period from 2009 to 2017, transport costs to reach an international gateway reduced significantly, giving rise to economic gains. Results from a general equilibrium model to evaluate transport interventions (see *appendix A* for the methodology) provides that—keeping all other factors equal—if the transport network had not changed between 2009 and 2017, income would have been 2.43 percent lower due to less international integration (table 4.5). National welfare, which encompasses benefits other than income, would also have been 3 percent lower. Estimates show these previous investments between 2009 and 2017 have decreased spatial real income inequality and helped spread international integration gains across the territory; the effects heightened when assuming no barriers to labor mobility.

TABLE 4.5. **Impacts of Connectivity Improvement between 2009 and 2017**

Impacts	With labor mobility barriers	Without labor mobility barriers
Changes in national income	+2.43%	+2.67%
Changes in spatial welfare inequality	−1.3%	−8.4%

Investments under Scenario 1, through connectivity upgrades in remote localities and nearby border gates, would expand opportunities for international trade, thus improving national income while reducing spatial inequality. In an economy where the domestic labor is not mobile, estimates place the increase at 0.2 percent; when assuming no constraint on domestic labor mobility the increase would be lower at less than 0.1 percent, as the relative gain from improved connectivity is lower based on an already mobile domestic labor market. Investments under Scenario 1 would lower spatial inequality of welfare, that is, would support inclusiveness, both with or without mobile labor markets; the decrease would be steeper without barriers to labor mobility (table 4.6).

TABLE 4.6. **Impacts of Future Connectivity Improvement—Scenario 1**

Impacts	With labor mobility barriers	Without labor mobility barriers
Changes in national income	+0.20%	+0.06%
Changes in spatial welfare inequality	−0.3%	−8.0%

Compared to investments around border crossing points, investing in the North–South Expressway would bring larger national gains from domestic connectivity, but smaller gains from better international integration. Investments under Scenario 2 (table 4.7) could potentially grow income by 0.12 percent. However, gains from investments in the North–South Expressway become much larger when workers can easily move toward more attractive regions. High mobility costs would prevent many workers from going toward locations that have benefited the most from better access to international gateways and global markets. Thus, if more workers had relocated over the past decade, the gains from transport investments would have been larger.

Under Scenario 2, investments in major economic corridors to connect already established cities would worsen the spatial inequality, if workers cannot relocate freely, as shown in table 4.7. Benefits of better connectivity toward global markets would be enjoyed mostly by localities along the corridor. However, by removing barriers to labor mobility, investments that focus on main economic corridors could reduce spatial inequality and contribute to the inclusive growth.

TABLE 4.7. **Impacts of Future Connectivity Improvement—Scenario 2**

Impacts	With labor mobility barriers	Without labor mobility barriers
Changes in national income	+0.12%	+0.39%
Changes in spatial welfare inequality	+6.0%	−10.1%

In sum, improvements in connectivity would generate positive impacts on national income, but investment impacts on spatial welfare inequality would depend on the degree of labor mobility barriers. This applies both to the actual transport investments and future scenarios of two very different types of investments—scattered and remote area-focused investments versus those concentrated along a major economic corridor.

CHAPTER SUMMARY

- Many spatial variations in multiple dimensions of economic outcomes exist in Vietnam. Greater density areas coincide with greater economic outcomes, such as GDP, employment, wages, incomes, and overall welfare.
- By analyzing the transport network between two time points, from 2009 to 2017, the extent of connectivity improvement at each commune level is measured in terms of travel time to their closest large city and international gateway as well as the average travel time to all other district centers. The analysis shows travel times significantly improved in all measures over this period.
- For the two time points, the analysis developed a market access index—a composite indicator that captures economic density and economic distance by aggregating population from one commune to all other communes in the country, weighed by trade costs between them—for the entire country.

- The analysis shows a sizeable but highly uneven improvement in market access index across Vietnam, primarily attributed to transport improvement rather than population increase.
- A rigorous economic analysis established the relationship between connectivity and economic outcomes, by comparing market access index and other socioeconomic census data at the commune level between 2009 and 2017, and general equilibrium models to estimate overall welfare effects.
- The spatial variation in household welfare and poverty in Vietnam is largely explained by limited income generated from off-farm employment in lagging areas. Generally remote and sparsely populated, the local economies in lagging areas of Vietnam depend mostly on external demand to generate growth and expand access to jobs; therefore, market access is crucial to improving economic opportunities in lagging regions.
- Estimates show improving market access helps mitigate the disadvantage of remoteness and low density in Vietnam's lagging regions. In high mountain communes, the probability of off-farm wage employment nearly doubles for both the lowest and middle densely populated communes, as market access improves from less than one standard deviation below the mean to within one standard deviation above the mean. Differences in market access account for 22 percent of the observed difference in access to off-farm wage jobs between ethnic minorities and the Kinh and Hoa, and a 29 percent difference in access between the inland delta communes and the other communes.
- To a limited extent, improved market access positively influences the level of wage earnings too, though other mechanisms linked to agglomeration matter more in this regard. Improved market access also positively associates with households allocating more agriculture land to non-cereal crops better suited for their land. Enhanced market access also helps married women access paid work more than it does their husbands, which could help close the gender gap in participation in paid work.
- The analysis modeled two future transport investment scenarios for their possible impacts on income and welfare increase, based on the Government of Vietnam's announced plans, namely on the North–South Expressway and rehabilitation and upgrading of the national highway system.
- The analysis shows these future investments would increase the welfare and income at all communes; however, increases would be highly uneven. Both scenarios are expected to reduce income inequality, but only without barriers to labor mobility within the country. With barriers, the inequality would worsen or remain the same level.

NOTES

1. For the purpose of the analysis, the main cities include the five most populous cities: Hanoi, HCMC, Haiphong, Cai Tho, and Da Nang. The main international gateways include the main sea ports (HCMC seaport complex, Haiphong seaport, Vung Tau seaport, Tien Sa seaport), the two main airports (Noi Bai airport in Hanoi and Tan Son Nhat airport in HCMC), and the land border at Huu Nghi in Lang Son province, toward China.
2. "Incomes" and "wages" are used interchangeably in this section; even though wage is only a part of total income, given the lack of data, the analysis here focuses on wages.
3. Nd is given by population estimates for each commune for 2010 and 2015 using the raster file "GPWv4" from UN population estimates. The trade elasticity equals 8, following Eaton and Kortum 2002.
4. The optimal time is computed using the ArcGIS network analysis tool. ArcGIS searches the full transport network and finds the fastest path between two population centers. For more information about ArcGIS, go to https://www.arcgis.com/.
5. The expressway between Cau Gie (south of Hanoi) and Ninh Binh was completed in 2012, the expressway between Noi Bai (north of Hanoi) and Lao Cai in 2014, and the expressway connecting HCMC, Long Thanh, and Dau Giay in 2015.
6. This uses the Oaxaca–Blinder decomposition (Blinder 1973; Oaxaca 1973), a popular method applied to study differences in an outcome variable among groups, often labor-market outcomes. The method divides the mean outcome differential between two groups into a part "explained" by group differences in endowment characteristics—such as education or work experience—and a residual part that cannot be accounted for by such differences in outcome determinants. The "unexplained" part is often used as a measure for discrimination as well as of the effects of group differential in unobserved variables.

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CHAPTER 5

Building Resilience

Jung Eun Oh, Xavier Espinet Alegre, and Raghav Pant

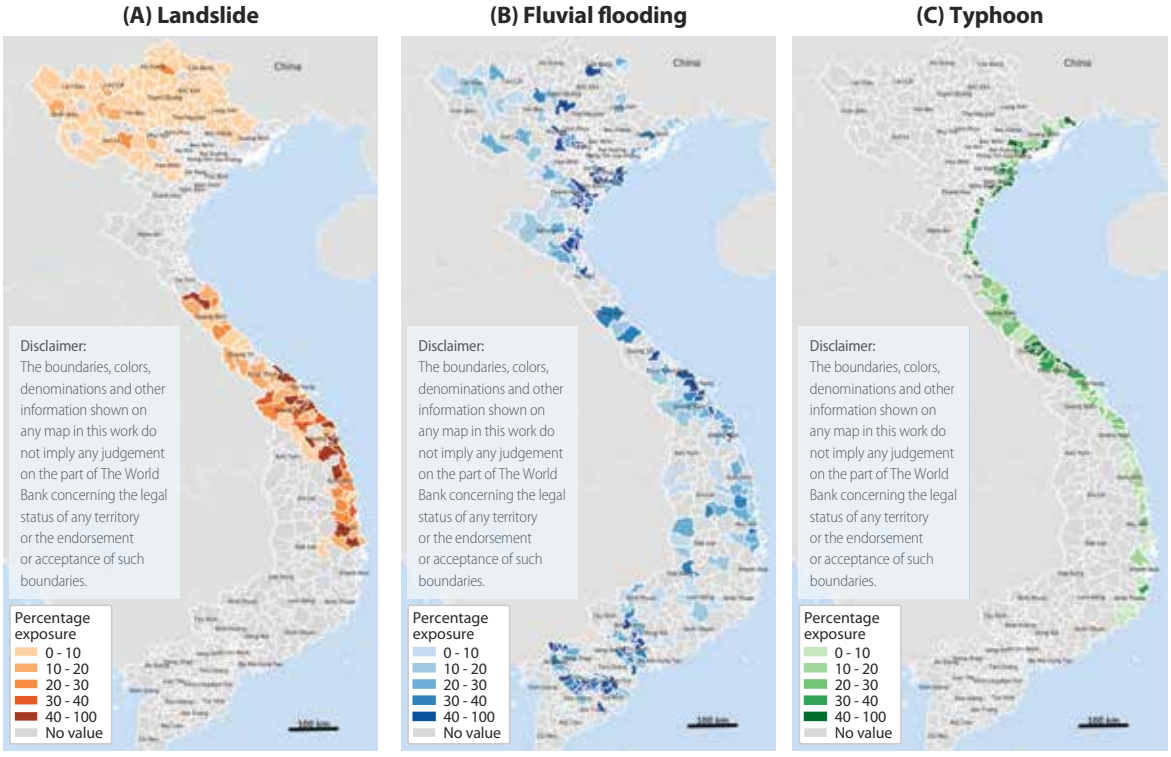
Vietnam is among the countries expected to be heavily affected by climate change and intensifying natural disasters, which will increase the vulnerability of the existing connective infrastructure and economic activities. Therefore, it is important to ensure Vietnam's infrastructure connectivity is resilient against future climate-induced risks. This chapter provides analytical evidence of increasing risks, while also identifying investments and measures to address these risks.

Resilience and Reliability of Connectivity

Vietnam's extensive transport network is exposed to various hazards, including landslide, fluvial (river) flooding, typhoon and flash flooding, all of which are increasing in intensity and frequency due to climate change (figure 5.1). With two or more natural disaster multihazard events per year, Vietnam ranks high as a natural disaster hotspot, with 60 percent of its land area and 71 percent population exposed to risk (Dilley and others 2005), which could result in annual average asset losses amounting to 1.5 percent of GDP and loss in consumption amounting to 2 percent of GDP (Hallegatte and others 2016). Extreme hazards are expected to intensify with climate change. It is possible that climate change will exacerbate these extreme hazards, even after factoring uncertainties in downscaled global climate model predictions (Irish Aid 2017; MoNRE 2009; World Bank 2011).

Examining the spatial patterns of the hazard exposures for nationally important transport networks can offer additional insights. A recent World Bank report provided that under no climate change scenario, approximately 188 km of the national highway network would be exposed to extreme flash flooding, which primarily affects mountainous terrains.[1] The impacts were analyzed under future climate change scenarios developed by the Ministry of Natural Resources and Environment (MoNRE), based on the internationally recognized Representative Concentration Pathways (RCP) 4.5 and 8.5 scenarios. Under the RCP 4.5 scenario, the length of exposed highway would increase to 197 km by 2025 and to 222 km by 2050; under the RCP 8.5 scenario, the exposure length increases to 211 km in 2025 and to 235 km in 2050.[2] Under the future RCP4.5 scenario, approximately 720 km to 1,163 km of the national road network would be exposed to extreme river flooding (flooding depth exceeding 1 meter) in the current flooding scenarios; the network exposure lengths would increase to between 786 km and 1,180 km. Similar estimates apply to the railway network, which often runs parallel to primary road network (Oh and others 2019).

FIGURE 5.1. **Share of Road Network in Each District of Mainland Vietnam Exposed to Extreme Hazards**



Source: Oh and others 2019.

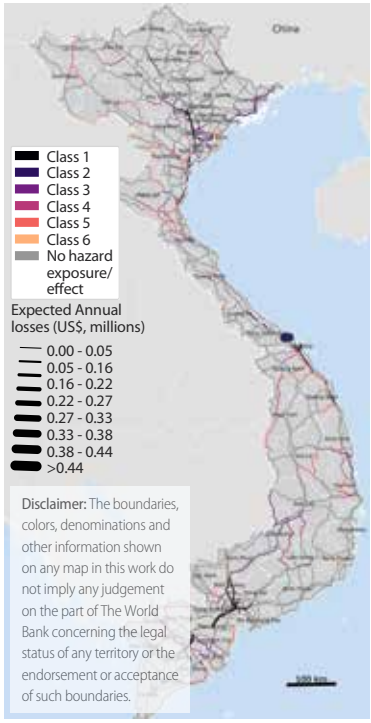
Key sea, air, and river ports in Vietnam are similarly exposed to natural hazards and to the risks of major flow disruption, with extreme intensity events becoming more frequent due to climate change. For example, the maximum hazard probability of the Ho Chi Minh City (HCMC) seaport complex flooding increases five-folds, from the current 0.04 (1-in-25 years flooding) without climate change to 0.2 (1-in-5 years flooding) under the RCP4.5 and RCP8.5 scenarios. The analysis observes similar trends for all major ports including Haiphong port; combined, these trends could translate into a disruption of 68,000 to 106,000 tons of cargo flows per day and would result in significant economic loss to Vietnam. Several inland waterway ports are susceptible to future hazards, including those in An Giang, Hai Phong, Thai Binh, and Quang Ninh provinces as well as HCMC; the aggregate disruption under an extreme situation could be as high as 25,000 to 55,000 tons of cargo flows per day.

The expected potential economic impacts of disruptions caused by natural hazards could be significant, accounting for increases in transport rerouting costs and production reductions due to input–output links of goods moved on the affected transport link. The expected economic losses in case of various natural hazards can be calculated using a spatial analytical tool; figure 5.2 illustrates the example for the road network. Some transport links, which carry significant traffic yet have few rerouting options, could incur substantial economic loss, with estimates as high as US$20 million. The analysis shows risks along key sections of the QL1A trans-Vietnam highway are predominantly driven by landslides and typhoon flooding, while river flooding affects links around HCMC and Thua Then Hue, while flashfloods affect some mountain provinces due to the underlying hazards concentrated only in those regions.

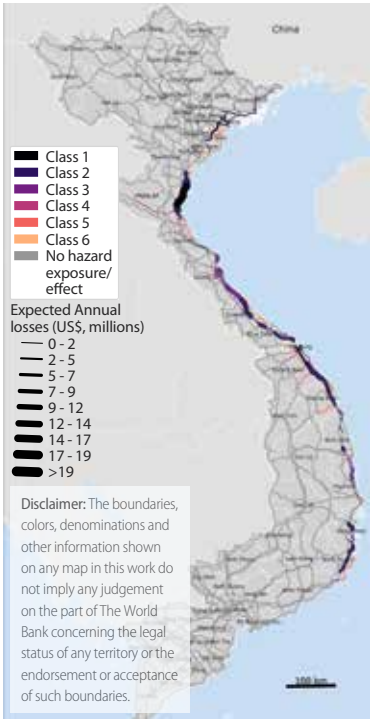
FIGURE 5.2. **Expected Economic Loss along the Major Transport Network, Due to Disruption Caused by Various Natural Hazards**

(A) Road network, landslide

(B) Road network, river flooding



(C) Road network, typhoon



(D) Railway network, landslide

(E) Railway network, river flooding

(F) Railway network, typhoon

Source: Oh and others 2019.

The expected losses would increase under climate change scenarios. As shown in figure 5.3 for river flooding, the maximum failure risks increase on most network links. For a large part of both the road and railway networks, the risks would increase more than 40 percent in the future hazard scenario (RCP 4.5) in 2030. The increase supports a strong case to build resilience into transport connectivity against future climate hazards.

FIGURE 5.3. **Change in Maximum Failure Risks of Transport Network in 2030, under Climate Change Scenario**

(A) Road network under RCP 4.5 scenario

(B) Railway network under RCP 4.5 scenario

Source: Oh and others 2019.

Risk and Criticality-Based Adaptation Strategy

With the increasing intensity and frequency of natural hazards, it is imperative to improve the resilience of transport network as a strategy to support connectivity. A sound resilience strategy is multidisciplinary and should encompass: (a) good spatial planning of infrastructure based on economic activities and risks, (b) adequate technical standards commensurate with the risk level, (c) good construction quality and proactive maintenance of built assets, and (d)

sustainable management of the natural environment, water resources, and drainage systems to mitigate negative impacts on the built environment.

In addition to the above broader resilience strategy, **for the already-built infrastructure, it is important to identify any investments required for rehabilitation, reconstruction, or other engineering solutions needed to mitigate the risks.** In the above-referenced World Bank study (Oh and others 2019), the economic costs and benefits have been analyzed for selected engineering solutions commonly used in Vietnam, against the key infrastructure failure cases, such as erosion of pavement or slope, drainage failure, or structural failure (for example, collapse of bridges and culverts). Compared to the existing cost norms and standards, the cost estimates for some of the engineering solutions to "climate-proof" critical infrastructure could be as much as three times higher than their alternatives, depending on the structure, terrains, and the significance of risk exposure (table 5.1).

TABLE 5.1. **Estimated Costs of Adaptation Investment by Road Class and Terrain in Vietnam**

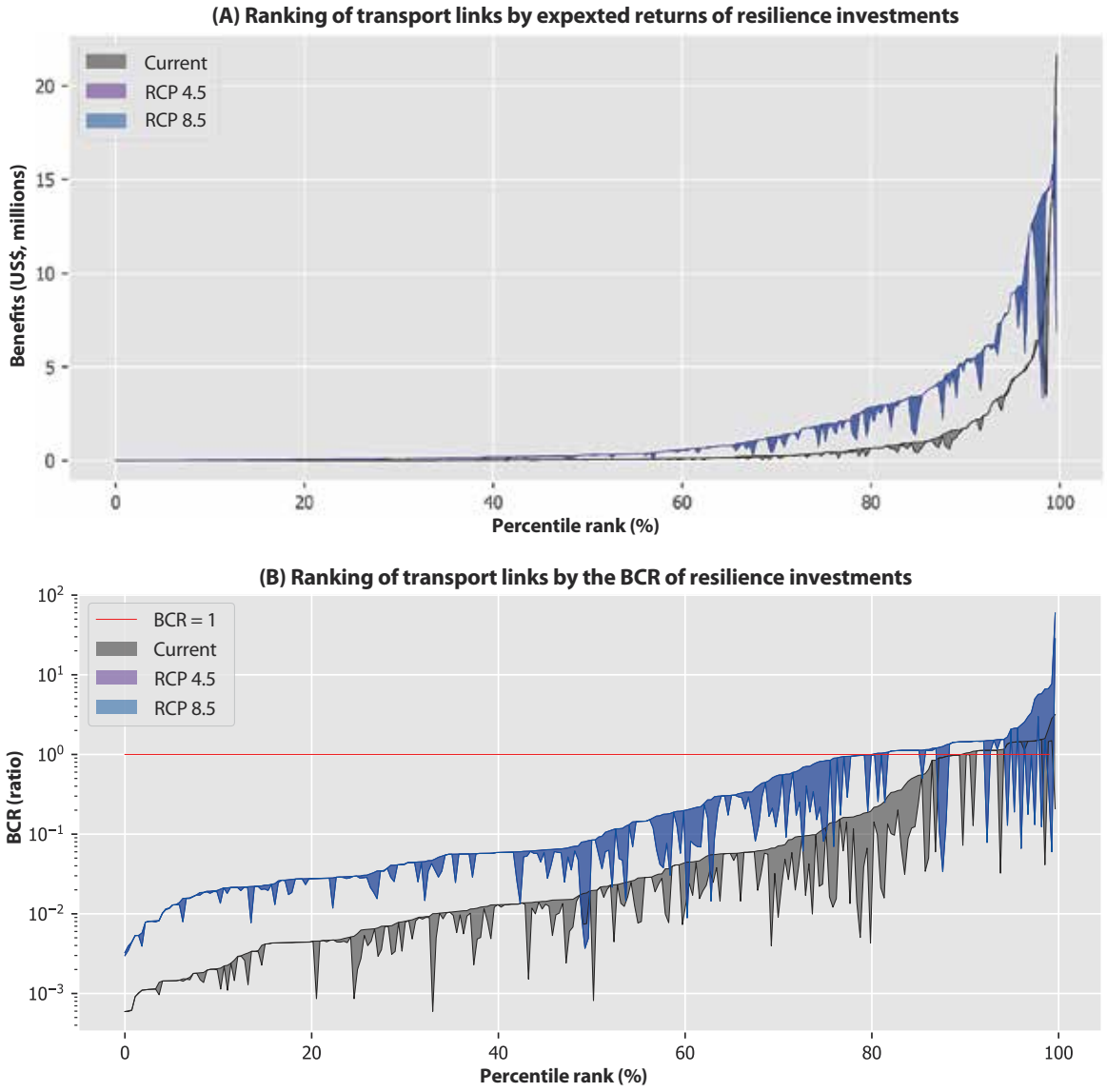
Prototype road	Terrain	Cost of adaptation investments (US$/km)
National highways: Two-lane, 22.5 meters wide	Flat	1,535,000
	Mountain	1,828,500
District roads: One-lane, 6.5 meters wide	Flat	808,000
	Mountain	1,439,000
Bridge	All	10,179,000

Source: Oh and others 2019.
Note: Cost estimates are for a typical road in each class and physical configuration.

Investments to upgrade or rehabilitate existing infrastructure would enhance its resilience and help avoid the estimated economic losses. The economic benefits of such investments represent the sum of the avoided annual expected rehabilitation costs for individual road links as well as the avoided expected annual economic losses (EAEL) from disruptions of transport freight flows caused by failures of individual road links, over an analysis period. The results suggest significant benefits of investing into building resilience, particularly along the expressway sections toward the eastern coastline. The benefit-cost ratios (BCRs) of adaptation can then be estimated for all identified road links, comparing the cost of adaptation investments and their economic benefits.

The above analysis suggests climate-resilient designs could increase the cost of construction significantly; however, the high costs would be justified for transport network sections entailing the high expected economic loss, due to their criticality to trade and transport and lack of rerouting options. Based on the risk analysis presented in figure 5.2, the benefits and benefit-cost ratios (BCRs) of total climate-resilient investments have been calculated for each transport section. The results, presented in figure 5.4, suggests that investments to improve resilience would be economically justified (that is, yielding a BCR greater than 1) for about 20 percent of the transport network, compared to 10 percent without considering the future impacts of climate change. This provides a strong justification for upfront investments—based on the criticality and risk exposure of transport links—against the future natural hazards, which aggravate due to the climate change.

FIGURE 5.4. **Benefits and BCRs of Investments in Transport Resilience**



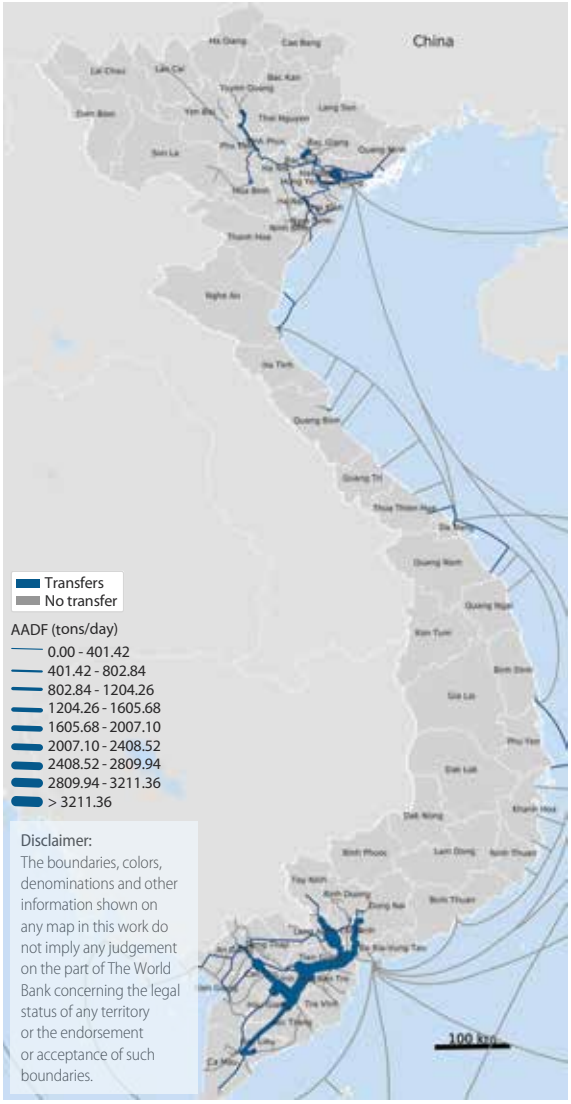
Source: Oh and others 2019.

Multimodality as a Resilience Strategy

Currently Vietnam's transport relies heavily on road transport, which carries three-quarters of the total freight tons and about a quarter of total ton-kilometers; in case of disruption, this high reliance translates into high expected economic loss. The analysis shows modal shifts from road to waterborne transport, such as inland waterway transport (IWT) and coastal shipping, would promote not only efficiency—due to the lower costs of waterborne transport modes—but also connectivity resilience. Even a 10 percent modal shift from road traffic to coastal shipping could result in a 20 to 25 percent reduction in economic losses, as shown in figure 5.5. This would, however, increase the volume on IWT and shipping, and potentially require further investments to support the additional demand (figure 5.6).

FIGURE 5.5. **Reduction in Expected Economic Loss under Modal Shift Scenario**

FIGURE 5.6. **Estimated Additional Flows on Waterborne Transport under Modal Shift Scenario**



Source: World Bank estimation based on the 2017 Economic Census conducted by the GSO. See: https://www.gso.gov.vn/default_en.aspx?tabid=515&idmid=5&ItemID=19083.

However, achieving even a 10 percent modal shift from road to waterborne transport presents a challenging undertaking. This would require concerted efforts through good planning, improvement of intermodal connectivity, and appropriate incentives, such as through pricing. In particular, the following critical gaps in achieving these modal shifts need to be addressed: (a) the lack of containerization on inland waterway transport, (b) underdeveloped inland river ports with good hinterland connection, and (c) limited coastal shipping on the north–south route, along Vietnam's long coastline. Each is discussed in detail, below:

The IWT network in Vietnam is underutilized due to the many shippers' preference for the point-to-point flexibility of trucking. Greater use of IWT could be encouraged by promoting "container-on-barge" services, which would bring added flexibility for IWT and better compete with trucking. The lack of containerization has resulted in IWT becoming dominated by bulk commodities such as coal, construction materials, fertilizers, and cement. Other major road freight commodities could also potentially be containerized and transported through IWT. Rice offers an example of a commodity with significant potential for containerization; currently, only 4 percent of rice production in the Mekong Delta region is containerized. Among other benefits, containerization brings efficiency gains by facilitating faster transshipment. Recent successful examples in the Mekong Delta region suggest potential for cost reduction through containerization and a shift from road to IWT.[3]

Well-connected and well-equipped river ports comprise another critical missing link in Vietnam for intermodal connectivity between road and IWT. As discussed in chapter 1, many of the existing river ports are old, poorly-equipped—generally without container-handling facilities—and poorly-connected to the road network. This aging port infrastructure has discouraged intermodal connections between road and IWT, while also restricting the use of IWT to a few routes connected mostly through waterborne transport. While additional investments in river ports are needed, most of which would be invested in and managed by private entities, two barriers prevent such investments:

- Without public investments to improve navigability of waterway corridors and connectivity with the road network via hinterlands, the private sector is unlikely to make investments to better equip their port operations
- Returns on investments in port upgrades would also depend on the hinterland economic activities, which would affect cargo demand handled in the upgraded port.

Both barriers suggest the need for strong port development coordination between private port operators and provincial or city governments, perhaps warranting a joint development.

The potential for domestic coastal, short-sea shipping in Vietnam has not been fully explored. Domestic cargo transportation through coastal shipping accounts for only 39 percent of the total coastal cargo throughput, in part due to the absence of a robust supply ecosystem as well as infrastructural constraints in and around the ports. On the supply side, very few shipping services offer coastal shipping, passing the additional costs, terminal handling charges, for example—which account for 50 percent of the total coastal shipping costs—along to the client. Currently, terminal handling charges are uniform for both international and domestic cargo. However, ports have traditionally preferred international cargo over domestic cargo, in terms of turnaround time and berth allocation. On the infrastructural end, while the major export–import oriented ports are being updated with the latest cargo-handling facilities, additional policy support could be used to promote Roll-on/Roll-off (RO–RO) vessels with built-in or shore-based ramps. This would enable loaded trucks to roll directly onto ships, transfer through the sea, and then roll off from the ships to the ports. These trucks can then directly proceed to delivery, reducing dependencies on port handling services and dedicated short-haul truck services. At present, RO–RO ships account for 0.04 percent of the cargo throughput from the HCMC port (JICA 2010).

CHAPTER SUMMARY

- Vietnam is among the countries most exposed to various forms natural hazards, which can result in significant economic loss; thus, building up resilience and reliability of critical transport corridors would be a sound pro-trade strategy.
- The concept of "expected economic loss" is developed and used to quantify the expected increase in transport costs due to rerouting and loss of production due to disruption, under various natural hazard scenarios.
- For particularly critical and vulnerable transport network sections, upfront investments for upgrading and improvement are economically justified; climate change calls for greater investments due to increased frequency and intensity of various natural hazards.
- Multimodality should serve as a strategy for better connectivity in general, and under risk scenarios in particular, as it can reduce the excessive reliance on road transport in case of disruptions.
- To promote multimodal connectivity, both as a way of reducing transport costs and enhancing resilience of connectivity, several measures need to be implemented, including promotion of inland waterway transport containerization, development of river ports with strong hinterland connection, and promotion of coastal shipping along the north–south corridor.

NOTES

1. Extreme flooding means the level that would occur with the probability of once in every 1,000 years.

2. Representative Concentration Pathway (RCP) is a greenhouse gas concentration trajectory. The RCP 4.5 scenario assumes emissions peak in 2040 and decline thereafter; the RCP 8.5 scenario assumes emissions will continue to rise throughout the current century.

3. According to Lam, Sriram, and Khera (2019), Tan Cang Saigon General Company, established by the Saigon Newport Corporation, reports that cargo transported by barge from the Mekong Delta ports to Cat Lai port in HCMC reduces costs by approximately 7 percent for each 40-foot container; for each 30-foot container, costs reduce by about 20 percent.

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CHAPTER 6

Recommendations

In this report, we have assessed the state of connectivity of Vietnam under three economic goals—to further integrate Vietnam with both global and domestic markets, and in doing so, ensure inclusion and resilience. This chapter lays out key recommendations for policy makers and other stakeholders, along with their suggested implementation timeframe. We emphasize that spatial development in Vietnam will be shaped by the outcomes of numerous decisions and actions by both the public and private sectors. The Government alone cannot plan or predict commercial decisions made by firms, investors, and individual consumers, decisions that affect formation of economic densities and connectivity in between. Thus, it is critical for the Government to enable, facilitate, and incentivize other decision makers, with an aim to shape the future of connectivity.

For Integration with Global Markets

Recommendation 1: Re-orient transport and spatial planning to support critical value chains

The nine most export-critical sectors analyzed in this report account for more than 70 percent of Vietnam's total export and cover industries where Vietnam has comparative advantages in terms of natural endowment, low cost labor, skilled labor, open trade relationships with its partners, among other aspects. As presented in chapter 2 of this report, the key sectors' value chain linkages, covering participating localities and economic clusters that provide inputs or consume final products, can be identified using various economic statistics and mapped on the transport network.

Based on this analysis, we recommend that transport planning and investment strategies be informed by this type of spatial analysis, to promote a robust, trade-oriented connectivity policies and investments. At present, the objectives of enhancing trade competitiveness are not explicitly linked with the objectives of improving connectivity. Trade information, especially on value chains, is rarely used in policy formulation. In addition, a lack of in-depth analyses remains on spatial structure and connective propensity along various linked segments of value chains to inform relevant policies and investment for transport infrastructure development.

Mainstreaming such an analytical approach for future decision making, beyond what was carried out for this report, first requires creating *the entire trade- and transport-link ecosystem*. This ecosystem would include the systematic collection of relevant trade and transport data—a system that consolidates and analyzes data, and also develops procedures through which the analytical outputs have tangible influence over planning and investment decision processes. We advise sharing relevant trade and transport data with the private sector, which can then make business decisions based on overall economic trends and public sector investments, including strategically locating along relevant value chain linkages or deepening participation in certain value chains. The ongoing efforts by the Ministry of Transport (MoT) to establish the Vietnam Logistics Statistical System is an important step in the right direction.

Specific actions *in the short term* would include:

- Improve collection and analysis of data related to trade, value chain, logistics, and transportation through a mandatory data-sharing arrangement among public and private stakeholders in trade, logistics, and transport services
- Designate an entity with the capability to collate and analyze connectivity data and establish and assess key performance indicators (KPIs) that measure the degree to which transport and logistical connectivity serves critical value chains

In the medium term:

- Make KPIs in trade, logistics, and transportation available (with some information tiers available to paying customers and others free to the public)

- Establish a legal and regulatory framework to utilize trade data, particularly value-chain information for transport infrastructure planning

In the longer term:

- Establish a mechanism to involve key private sector players—shippers, logistics providers, other industry players—in the infrastructure planning process

Recommendation 2: Reconfigure the network of international gateways

Vietnam should address the capacity bottlenecks, congestion, and demand–supply imbalance at its international gateways, while offering flexibility to accommodate the evolving structure of its trade. As Vietnam sustains its trade growth, cargo volumes handled at Vietnam's largest international gateways experience rapid increases in ensuing congestion—creating a need to expand the physical capacity of gateways that might pose critical chokepoints in the near future. However, some gateways are situated within built-up urban areas with limited expansion possibilities. The Government of Vietnam has long recognized this issue and plans to build new gateways, such as the planned airport in Long Thanh, that would share the increasing air traffic volume with the existing inner-city airport at Tan Son Nhat.

Some major international gateways face serious issues concerning inland connectivity. Existing road corridors often go through the inner city, aggravating congestion with a mix of truck traffic traveling to ports and commuter motorbikes. Several maritime ports have insufficient capacity to handle inland waterway barges, which often provide gateways with critical inland connectivity. Such situations are caused in part by the lack of coordination around development of international gateways and their connectivity; the former is driven by the national government, while the latter is provided by provincial or city authorities, with unmatched budgeting priorities and timeframes. The case of Vung Tau seaport complex, which is built to handle large intercontinental ships but poorly connected both by road and inland waterway, serves as an example. We therefore recommend coordinating transport planning with the explicit objective of strengthening multimodal and intermodal connectivity, strongly emphasizing critical chokepoints and hinterland connectivity around the key gateways.

Changes in product-based export structure should also be required priorities when building better logistics and connectivity for higher-value product exports. A transport system aiming to promote export should thus consider this shift of logistics perspectives, especially with regard to prioritizing investment into appropriate types of trade gateways. Therefore, future policy and investment strategies around international trade gateways should be informed not only by trade growth, but also (and more importantly) by the structural changes and development of domestic value chains. This is closely linked to Recommendation 1.

Moreover, we recommend considering these critical gateways as a network with complementary roles played by each component, while discouraging wasteful competition among various localities seeking to become the country's main gateways. Consolidation of gateway structure and capabilities to handle intercontinental vessels, supported by good domestic shipping and land connectivity,

is beneficial for all stakeholders in Vietnam—importers, exporters, and shippers alike—as such an arrangement can significantly lower transit time and reduce trade costs with some of Vietnam's major trade partners. Vietnam is unlikely to attract large vessels with a fragmented port system without the ability to consolidate sufficient volumes in any one port.

Specific actions *in the short term* would include:

- Prioritize short-term measures to relieve congestion at choke points around key international gateways, for example, through provision of centralized parking bays and consolidation yards
- Establish a coordination mechanism between central, provincial, and local governments and between provincial authorities to coordinate implementation plans for connective infrastructure around key international gateways

In the medium term:

- Conduct network-level gateway planning, rather than for an individual gateway or province, focusing on further consolidation of import and export volumes and lower trade costs
- Implement additional congestion mitigation measures, such as widening connecting roads, upgrading pavement and structure strength to accommodate heavy vehicles, lane reservation, and dedicated truck corridors, including around Noi Bai airport and Vung Tau seaport complex

In the longer term:

- Complete development of major international gateways in the north and south, including Long Thanh airport and Lach Huyen port
- Aspire to realize the vision for major gateways to serve as regional transshipment hubs

Recommendation 3: Create "economic densities" along new corridors

On the one hand, Vietnam is striding toward reducing economic distances through its recent and ongoing investments in connective infrastructure, such as expressways. Travel speed on new expressways is two-to-three times faster than the existing road network, resulting in significant reduction in economic distances. On the other hand, Vietnam has seen a proliferation of various economic clusters, such as industrial parks (IP) and economic zones (EZ). While they once might have been primarily driven by provincial-level initiatives and private sector investment, these economic clusters are no longer singular manufacturing enclaves, but rather nodes in a larger industrial—and well-connected—ecosystem. While many clusters have chosen to locate along the existing major transport corridors connecting major cities and/or international gateways, some existing clusters have reached a point where further agglomeration and concentration would result in lower return because of congestion—and possibly also rent increase.

Given the development, Vietnam now needs to maximize benefits from reduced economic distances and promote efficient and well-connected economic clusters through better integrating transport

and land-use planning. The rapid expansion the transport produces an urgency and strong need for proactive spatial planning around transport corridor development and economic clustering.

We are not recommending the Government select sites and carry out IP projects; the private sector can make locational choices based on their business needs and commercial considerations. Instead, we recommend prudent and no-regret planning decisions to encourage efficient use of future high-value transport nodes created alongside the newly developing connective infrastructure, such as North–South Expressway. Land-use plans around these critical national connective infrastructures, while under the responsibility of respective provincial authorities, should be coordinated as incentives for productive high-density use of such lands that can generate jobs and reap the benefits of good connectivity. Current regulations around land-use planning are governed by various socioeconomic objectives, such as environmental protection, agriculture, and food security, which could constrain conversion of former agriculture land into industrial or commercial use—for instance, after the development of a new expressway. While these objectives are important, a strategic approach to land use around high-value transport nodes would provide Vietnam opportunity to create an efficient network of well-connected economic clusters developed with sufficient density.

Specific actions *in the short term* would include:

- Assess, on a regular basis, IP and EZ performance and use of spatial agglomeration, and make the relevant information public
- Review relevant legislation concerning current spatial planning and define bottlenecks to integrating transport and land-use planning

In the medium term:

- Develop a mechanism to incentivize local authorities and the private sector to foster productive land uses—such as for industrial agglomeration and logistics services—around high-connectivity nodes created along new or upgraded infrastructure.

In the longer term:

- Involve relevant institutions to achieve coordinated planning between transport infrastructure and logistics infrastructure, such as warehousing, inland container depots, and land use.

For Integration across Domestic Markets

Recommendation 4: Upgrade connectivity "software" to serve domestic markets

Building upon the progress in developing the connectivity "hardware," that is, connective infrastructure, Vietnam needs to upgrade its connectivity "software," including the logistics service sector, the regulatory framework around supply chains and logistics, and the institutional framework around the logistics sector. Vietnam's logistics service providers (LSP) are fragmented

and small in scale: for instance, 50 percent of truck operators in Vietnam employ about three people and generate an annual turnover of less than US$0.5 million (Lam, Sriram, and Khera 2019). LSPs serving the foreign direct investment (FDI) sector are expanding and becoming more sophisticated, including through joint ventures with international players; however, domestic trade is still primarily served by rudimentary services. A growing base of urban consumers, who increasingly demand high-standards of services, such as safety, punctuality, freshness, and traceability of traded goods, provides an opportune moment to grow LSPs serving the domestic markets. While the private sector will play a critical role in FDI sector development, the Government could provide support by creating an enabling regulatory environment, enforcing standards, and "nudging" consumers to support a competitive market.

In chapter 3, we explored the example of perishable food. Considering the vast negative economic, environmental, and public health consequences of unsafe perishable food, Vietnam needs to upgrade the quality and safety of food production, transportation, and distribution. Notwithstanding the food safety laws and regulations already in place, monitoring and enforcement is extremely resource-intensive because of food chain fragmentation. For more effective regulation around food chain, Vietnam should strengthen the interagency coordination and introduce a risk-based approach. Involving both national and local authorities, regulatory and enforcement coordination is essential between the food certification system and production, sourcing, and transportation and distribution of food. The Ministry of Agriculture and Rural Development (MARD) has appropriately moved to focus oversight efforts on a risk-based approach, in order to prioritize various enterprises and product lines.

However, Vietnam cannot police its way to safe and sustainable value chains for perishable foods. The lack of demand for certified food and a refrigerated food chain is not rooted in the lack of demand for safety and quality, but rather in the lack of awareness and knowledge around the certification system, which leads to persistent consumer preference for traditional wet markets. Maintaining unbroken cold chains entails additional costs to the food logistics, and many consumers doubt the resultant price premium is worthwhile. Therefore, greater attention needs to be given to raising awareness and knowledge about safe and unsafe practices and building programs which facilitate behavior change. This does not mean that regulatory enforcement should be abandoned; the prospect of heavy fines could deter firms from willful noncompliance. Yet, the bulk of regulatory delivery should be geared toward motivating, enabling, rewarding, and communicating sustained improvements and regulatory compliance.

Underlying the above specific food chain case, Vietnam needs to address the broader logistics sector market conditions and regulatory framework to upgrade the connectivity "software." The Government is well placed to provide incentives for expansion and further investments into the logistics sector, allowing the sector to grow and become more efficient (for example, by using more fuel-efficient fleet or reducing empty backhaul). International experiences suggest financial incentives encourage investments to expand the scale of truck operations, conditioned on the continued growth of the borrower. Such an approach, known as a "growth-based lending scheme," would give smaller operators access to cheaper loans with which they can upgrade their fleet and grow their business. Loans could be provided based on key performance indicators, such as fleet

size, employment, and revenues in recent years. As an alternative or complementary approach, allowing for or encouraging formation of cooperatives can help LSPs achieve scale and cargo consolidation.

As discussed above, the LSPs in Vietnam are predominantly 1st or 2nd Party Logistics (1PL or 2PL) establishments; the small market for 3rd and 4th Party Logistics (3PL and 4PL) businesses is focused on import and export clientele. Domestic traders and consumers lack the brokerage solutions and logistics services to improve logistics efficiency. Therefore, we recommend promotion of the brokerage sector, particularly aiming at creation and development of pan-Vietnam operations, through regulatory measures such as permitting greater foreign capital share in such establishments and encouraging cooperatives of smaller brokers.

In addition to the regulatory measures, advancement in information and communication technologies provide ample opportunities to grow non-asset-based logistics operations, including 3PLs and 4PLs. Several successful international models for digital freight aggregator models can be replicated and further fostered in Vietnam. Such logistics technology platforms use algorithmic, real-time matching for instant online transactions—with value-added features, such as dynamic lane rates, end-to-end tracking, and dynamic pricing options based on goods type (apart from size and weight). Increased investments and promotion of such innovative logistics solutions could potentially disrupt the industry. E-customs, electronic recording and transactions, and other applications can significantly improve the efficiency of various logistics services, in face of increasing demand for traceability, timeliness, and other complex customer needs.

Specific actions *in the short term* would include:

- Legislate for scale and competitiveness of the trucking industry, by providing incentives for forming cooperatives, full cold chains, pan-Vietnam brokerages, and so on

In the medium term:

- Introduce financial support, such as a growth-based lending scheme, by designating the trucking and other logistics industries as a State Bank of Vietnam's "priority sector" for financing
- Incentivize investments in digital freight aggregator models through government policies promoting fundraising, research and development, FDI, mentorship, and open data sharing
- Promote electronic recording and transactions in inland waterway transport (IWT)

In the longer term:

- Bring more automation—not just at international gateway seaports—but also at major inland river ports, inland container depots, and other key facilities
- Embrace disruptive technologies for last-mile connectivity, freight brokerage, and various other logistics applications

Recommendation 5: Overhaul market infrastructure and logistics in cities

Vietnamese cities should upgrade, and in some cases relocate, their market infrastructures, in coordination with the cities' overall spatial and transport planning. Currently, Vietnam has around 83 food wholesale markets and nearly 2,000 community wet markets. Most of these are 20 to 30 years old, and the vast majority have not been renovated to improve hygiene, waste management, or foot and vehicular access. And, over time, the location of many of these markets has proven to be an issue due to changes in traffic flows or nearby residential, commercial, or administrative use. With few exceptions, these markets have been publicly owned and managed (sometimes contracted to joint stock companies). These owners and managers have faced persistent operating problems because (regulated) rental rates have been held very low, resulting in insufficient income for infrastructure maintenance and day-to-day management. Individual cities appear to be undertaking selective upgrades to some of this infrastructure or making decisions to relocate certain markets, especially wholesale markets, to peri-urban areas in the future. Few of these developments, however, appear to be happening as a broader strategic vision for the markets' future roles and functions, and possible changes in how they are financed and managed.

At the national level, an overall strategy or master plan for wholesale markets would recognize a likely market hierarchy and provide guidance on infrastructure design and options for financing and commercial services. The Ministry of Industry and Trade (MoIT) has begun the process of developing such a plan, based upon Decision 6841/QD-BCT, issued in June 2015. The experiences of China and the Republic of Korea in developing similar national master plans should be instructive for Vietnam. At the municipal level, the promotion of investment in new or upgraded wholesale markets should be integrated with plans for regulatory oversight (animal health, food safety, and plant quarantine, for example), transport and freight corridors, and the upgrading of wet markets—in the context of overall urban planning and expectations about how demographic, dietary, and shopping patterns will evolve. Leading cities should design and implement a strategic vision to upgrade the backward logistical and informational links of community wet markets.

This goes beyond the food chain to the broader consumption sector, particularly in urban areas. Currently, with few exceptions, matters of needs, risk, and performance of food system and other urban consumption activities are not mainstreamed into urban land-use planning, logistics, environmental management, or overall municipal governance. Most agricultural strategies and plans identify cities as end points for consumption, but not as active, responsible players in governance of supply chains including for food. As a result, while many cities increasingly recognize the above noted problems, most responses have been modest, piecemeal, and reactive, and therefore thoroughly inadequate. Instead of this "business as usual" approach, cities should adopt a paradigm shift, which involves integrated strategies for promoting resilient, inclusive, competitive, and environmentally sustainable urban supply chain and market infrastructure.

In major urban areas, current practices in transport planning focuses on transport infrastructure, such as the city's road network, bridges, urban railways, and public transport systems, omitting consideration for urban logistics. This needs to change. The range of logistics facilities—such as inland container depots, cargo handling facilities at critical interurban connection points

(railway stations, domestic airports, and ports, for example), urban distribution centers, and small warehousing in urban areas—should be included in the formal transport planning process, to ensure efficient movement of goods for businesses and consumers alike, without negatively affecting the urban environment and livelihood. This inclusivity of logistics would become more important as e-commerce activities and domestic consumptions continue to expand in cities; the increasing trends of e-commerce across Vietnam, particularly in urban areas, would further drive demand for first- and last-mile logistics, which could be costly due to sections of narrow road networks in many Vietnamese cities. Emerging e-commerce players in Vietnam identify the lack of efficient logistical business solutions among their top three concerns.

A challenging and complex problem, managing urban transport involves multiple stakeholders with conflicting interests. Businesses rely on timely delivery of goods to meet the customers' needs; urban commuters wish to move trucks out of commuting routes; and urban consumers want their online shopping delivered quickly and on time. While it is tempting to impose physical regulations such as truck bans in cities, this would naturally compromise some stakeholder interests and likely incur other costs. Therefore, we see a crucial need for cities to embrace urban logistics within their transport planning process, strategically locate and ensure land availability for critical logistical facilities, and build a network of services and regulation systems to meet the complex and evolving needs for the urban mobility of both people and goods.

Specific actions *in the short term* would include:

- Mandate local authorities, especially in large urban areas, to include considerations for market infrastructure and urban logistics in spatial planning
- Dedicate truck lanes for port–city roads

In the medium term:

- Construct urban consolidation centers (UCCs) in the outskirts of Hanoi and Ho Chi Minh City (HCMC) to consolidate and deconsolidate cargo
- Construct logistics centers near ports, such as Haiphong, to prevent unnecessary traffic from traveling through city centers

In the longer term:

- Integrate land-use and multimodal transport planning to better separate passenger and cargo traffic

For Inclusion

Recommendation 6: Connect low-density communities to markets

Vietnam should continue providing connectivity for remote and low-density areas of the country, connecting them with main economic corridors to reduce economic distance and improve market

access for all localities. Our empirical analysis provides powerful evidence that connectivity brings more employment opportunities, greater wages, and better opportunities to participate in domestic and international trade, thus improving welfare. We also found connectivity can offset the negative impacts low density has on employment potential and wages; therefore, providing connectivity is even more critical for Vietnam's low-density communes.

By examining the relationship between the transport network changes from 2009 to 2017 and the socioeconomic characteristics of all communes, we found that the significant improvements in transport connectivity during the period led to wage and welfare increases across the country. However, communes have experienced a highly uneven magnitude of these benefits, depending on the commune's economic distance to economic opportunities. When we analyzed the counterfactual of population and welfare gains at the commune level without transport network improvement, we found that transport connectivity has slowed down the concentration of economic activities in the two major cities, Hanoi and HCMC. This suggests that improved connectivity and the resultant increases in wages have allowed communes outside the major cities to retain population and improve welfare.

The market access index, a composite indicator of population distribution and travel time (or trade costs, which is assumed to be proportionate) represents a locality's access to economic opportunities. Calculating the market access index for all communes for the two time points, in 2009 and 2017, we found the market access index improved significantly thanks to the improvements in transport connectivity. Market access index is higher for communes well-connected to major transport corridors, such as expressways and international gateways, and the broader opportunities they can provide. In other words, future investments in transport toward inclusion should focus on connecting remote areas to major transport hubs and corridors, rather than connecting to adjacent communes and towns, which might not have sufficient densities to reap the benefits of connectivity.

More than other factors such as education attainment or agriculture endowment, market access can explain significant differences in off-farm employment across households in various geographical locations, suggesting the importance of connectivity in improving the likelihood of employment and welfare levels for Vietnam's rural communes.

Specific actions *in the short term* would include:

- Increase construction cost norms for road construction in mountainous areas

In the medium term:

- Evaluate the level of inclusiveness of connectivity on a regular basis by using surveys to institutionalize market access assessment in all localities at the aggregate and household levels

- Cooperate with logistics services providers to use National Target Programs (NTPs) to help local government subsidize logistics stations to link deliveries between cities and remote areas.

In the longer term:

- Inform investment decisions by "connectivity impact assessment" on welfare and inequality
- Embrace disruptive technologies for last-mile connectivity, freight brokerage, and various other logistics applications

Recommendation 7: Complement connectivity with social and economic supports

Vietnam should employ complementary policies, such as lowering barriers to labor mobility and providing universal access to quality education and health, in parallel with investments and policies for connectivity improvement. Our analysis showed the welfare gains from improved connectivity will be greater with no constraints to labor mobility. By facilitating the free movement of people to locations offering opportunities for better jobs and higher wages, in part thanks to their better connectivity, the economy as a whole can maximize the benefits of improved connectivity.

At household levels, while we found good market access strongly correlated with positive economic outcomes, this explains only around 30 to 34 percent of gaps in off-farm employment across geographical locations and ethnicities. The remaining gaps are explained by other factors, such as education attainment and agriculture-related endowments and resources, suggesting that improving connectivity alone is not sufficient to create an inclusive welfare increase across Vietnam; to be most effective, efforts to improve connectivity should be accompanied by complementary policies.

Specific actions *in the short term* would include:

- Delink social health insurance from the registration location
- Equalize access to services for migrant workers and their families to reduce barriers to labor mobility
- Improve the labor market information system in lagging areas

In the medium term:

- Leverage digital technologies to deploy agriculture market information
- Support vocational training to develop producer services, such as logistics services and business and accounting services, in secondary cities in the Central Highlands and Northern Mountainous regions

In the longer term:

- Abolish use of household registration status to determine access to public services
- Promote skills development to support development of secondary economies

For Resilience

Recommendation 8: Invest in "smart resilience" based on criticality and risk

In the face of increasing intensity and frequency of natural hazards, Vietnam should build resilient and reliable connectivity. Our analysis estimated the substantial economic loss caused on connective infrastructures by natural hazards, considering not only damage recovery costs, but economy-wide impacts on value chains from flow disruptions. Some critical transport links located along coastal lines, mountainous areas, or flood-prone terrains are highly vulnerable to various climatic events. Significant upfront investments are therefore justified to strengthen their resilience and reduce their vulnerability; even greater investments are justified under future climate change scenarios, which show the increasing likelihood of extreme events.

Similar to the above, mainstreaming investments in resilient and reliable connectivity would require the establishment of a policy-making and investment-decision framework that involves multiple stakeholders, such as the MoT, Ministry of Natural Resources and Environment (MoNRE), and MARD, as well as provincial authorities. These involved stakeholders would share critical data, such as locations and conditions of transport infrastructure assets, meteorological analysis on the likelihood of climatic events, hydrological models estimating the impacts of precipitation on the ground, and geological information to understand landslide susceptibility as well as the spatial distribution of population and economic activities. Such spatial information should be aggregated and analyzed to inform investment priorities and specific resilience measures appropriate for the level of risks.

Given the limited resources for maintenance and upkeep of the existing transport network and the substantial need for investments, investments for resilience and reliability should be carefully prioritized on the basis of criticality, and should consider traffic volume, rerouting costs, and availability of alternative routes. We recommend applying the above-described "value chain criticality" concept to inform investment strategies for resilience.

Specific actions *in the short term* would include:

- Establish and strengthen the interministerial data-sharing regime to integrate economic, natural and climatic, transport, and physical asset data as a basis for criticality and risk assessment

In the medium term:

- Establish or refine the geospatial, data-driven, and risk-based asset management system, integrating it with resource allocation and budgeting processes

In the longer term:

- Institutionalize a risk-informed asset management system for key transport infrastructure assets, including road, inland waterway, and railway networks

Recommendation 9: Promote multimodal transport as a resilient strategy

Considering the following two facts: (a) Vietnam's economic activities rely heavily on road network, part of which is vulnerable to future natural disasters and experiencing burgeoning congestion, while at the same time, (b) Vietnam's natural endowment—such as its inland waterway network and long coastlines along the country's main corridor—is underutilized and not fully explored, we can derive that multimodal transport makes a strong connectivity strategy, in relation to both transport costs and connectivity resilience. Our in-depth analysis combining multiple layers of geospatial information supports this argument: even a modest modal shift from road to waterborne transport, which would be economically beneficial given the lower transport costs of the latter, would reduce risk exposure and improve resilience of the overall transport network.

In reality, however, achieving multimodality is a challenging and complex undertaking that requires infrastructure development, a regulatory framework, market incentives, and overcoming inertia. We argue that the most critical barriers to multimodality include the lack of inland waterway transport containerization combined with the lack of well-connected and well-equipped river ports to facilitate transshipment and handling of container-on-barge cargo, along with the underutilized potential for domestic coastal shipping.

Vietnam could unleash the further potential for inland waterway transport through containerization. While private sector players such as shippers and LSPs would make the necessary investments in containerization, by creating a conducive environment through an improved waterway infrastructure, the Government would provide a consistent capacity to handle large vessels, thereby supporting safe navigation via a vessel traffic management system, and enhancing hinterland connectivity of river ports in key locations. Specifically, the municipal or provincial government could play a more active role in port development through adoption of a landlord port model, leading to joint development agreements between private port operators and provincial or city governments. These subnational governments have a legal responsibility to purse national goals in IWT development and would acquire a strong interest in the flow-through economic benefits successful port activity could bring. Under such a model, the public sector (local governments) would fund, fully or partly, investments in the port substructure (such as approach channels, quay walls, and berth depth) and road connectivity to main highways and make land available for expansion. This public investment would be subject to a firm commitment by the private terminal operators to match investments in logistics assets such as cranes and warehouses.

By reducing the current barriers, Vietnam could also further promote coastal, short-sea shipping—especially for domestic flows. We recommend measures such as lower terminal charges, and allocation of specific berth capacity and timeslots for domestic coastal shipping, which would encourage more domestic shipping via coastal routes. VINALINES is among the few operators currently offering scheduled services for North Vietnam–South Vietnam coastal shipping (Blancas Mendivil and El-Hifnawi 2014). In addition, a shipping exchange platform to help match demand with supply and publicize information on shippers' demand and shipping rates would facilitate and encourage operators to provide more coastal shipping services.

Specific actions *in the short term* would include:

- Bring more automation not just at international gateway seaports, but also at major inland river ports, inland container depots, and other key facilities
- Promote electronic recording and transactions in IWT

In the medium term:

- Promote coastal shipping on north–south corridors by encouraging more coastal shipping lines, domestic shipping centers, reduced port-handling costs for domestic cargo, and increased RO–RO vessels that promote trucking-coastal itineraries
- Promote container-on-barge services to boost IWT usage by adopting fleet sizes, designs, and waterways suitable for containerization, allocating berthing windows at maritime ports for IWT barges, along with improving container handling facilities at river ports

In the longer term:

- Develop landlord ports in two to three select strategic locations to promote waterborne transport and intermodal links between land-based and waterborne transport

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Appendix A: Data and Methodology

Data Used for the Report

We used various sources of data mostly from official sources published by government agencies, unpublished information shared with us, and other data generated by original work of the World Bank teams through surveys, focus groups, and so on. To enable spatial analysis, we converted much of the census data obtained for administrative locations of Vietnam into geospatial format. Table A.1 summarizes the key data used for the report analysis.

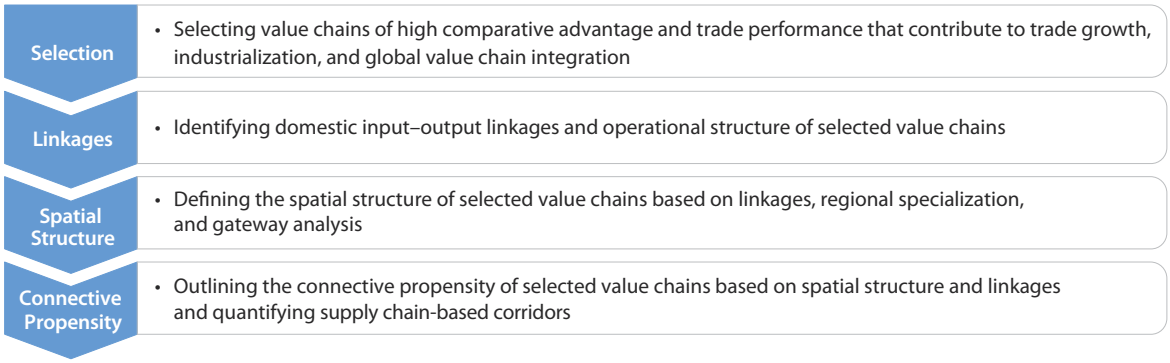
TABLE A.1. **Summary of Key Data Used in the Report Analysis**

	Data	Year	Data format/type	Source
Trade	Commodities, exports and import in all international gateways (air, sea, road, and rail)	2011, 2016	6 to 8-digist HS	General Department of Vietnam Customs
	Employment, LQ data by commodity by province	2011, 2016	Excel database	WB team
Transport infrastructure	National railway and inland waterways	2008, 2017	GIS	Ministry of Transport
	Road network: Expressways, national roads, provincial roads, secondary and tertiary roads	Pre2010, 2017	GIS	MONRE, WB consultant
	Locations, capacity and traffic/ handling volume of seaports/airports/border gates	2008, 2017	GIS and statistics	Ministry of Transport
Logistics and transport operation	Commercial Vehicle Fleet System data	2017	GPS signal (big data)	DRVN, data mining by WB consultant (P164018)
	Detailed surveys on trucking companies	2017-18	Questionnaires and responses	WB consultant (P164018)
	Detailed data on railway traffic and operational performance	2017	Excel database	WB consultant (P161178)
Firm activities	Enterprise census	2006, 2011, 2016 (with location identifiers)	Excel database	GSO
	Input–Output Table: 164-product matrix	2012- the latest	Excel database	GSO
	Special Economic Zones, EPZs, Industrial Parks, High-Tech Zones	2016 (with location)	GIS and Excel database	Ministry of Planning and Investment, WB consultant
	FDI registration and implementation	2018	Excel database	FDI General Department, MPI
Household welfare	Population and Housing Census	1999, 2009, 2014	Excel database	GSO
	Population data	2010, 2015	GIS (Raster)	UN
	Agriculture Census	2006, 2011, 2016	Excel database	GSO
	Economic Census / Census of Business Establishments	2007, 2012	Excel database	GSO
Administration	Administrative boundary	District level: 2012, 2014	Commune level: 2016	GIS, GSO, WB consultant
	People Committee location	2016	GIS	MONRE, WB consultant

Methodology: Value Chain-based Connectivity Analysis

The proposed value chain-based connectivity assessment is built on the approach employed in the study *Trade Facilitation, Value Creation, and Competitiveness: Policy Implications for Vietnam Economic Growth* (Pham and others 2013). Following this approach, the analysis consists of four integral steps as summarized in figure A.1. Hierarchical structure of a value chain is defined on input–output linkages and spatial industrial concentration of all segments.

FIGURE A.1. **Value Chain Connectivity Methodology**



Source: Based on World Bank 2013.

Selecting key value chains

The *first step* is to analytically identify key value chains for this study where Vietnam is already competitive. Four sets of criteria for identifying key value chains include: (a) high trade performance and high importance in the economy; (b) high comparative advantage; (c) high value added and potential for job creation; and (d) in line with the Government's priority.

Identifying value chain linkages

The purpose of *the second step* is to determine the production structure of domestic value chains comprising the identified key value chains by analyzing domestic input–output linkages. The value chain linkages are identified following four key steps: (a) determine first tier supplying sectors (sectors' backward linkages) using data from Vietnam's input–output tables for 2011 and 2016; (b) repeat the exercise in the first step multiple times to compute second-, third- or higher tier supplying sectors; (c) create diagrams of value chain linkages; and (d) refine linkages and diagrams based on expert views and sectoral data.

The first step, determining first-tier supplying sectors, is based on a sector's sourcing intensity, which is computed as the share of inputs from a supplying sector as percent of total intermediate inputs. We consider both imported and domestically purchased inputs, as both are combined in the I/O data for 2011 and 2016. Moreover, we only consider non-services and non-capital inputs. In most cases, we apply a sourcing intensity threshold of 2 percent, that is, we only consider non-services and non-capital inputs that represent at least 2 percent of total inputs. Sourcing intensity (SI), is defined as follows:

$$SI_{s,i} = \left(\frac{\text{purchase of input } s \text{ by sector } i}{\text{total intermediate inputs used by sector } i} \right) * 100\%$$

where *i* is a key value chain sector, and *s* is a sector supplying inputs to the key value chain sector.

The second step repeats the first exercise for various layers of backward linkages. That is, it considers the sectors that supply inputs to sector *s*. Since sourcing intensities of lower-tier sectors can vary across value chains, we select the most important supplying sectors based on an ad-hoc basis. We focus on those supplying sectors critical to the value chain. In other words, once the most important first-tier supplying sectors are identified, this exercise is repeated for the most critical inputs, all the way back to the third-tier supplier. The third step is to develop a diagram of value chain linkages for each of the key value chain sectors as well as the first, second, and third tier supplying sectors.

The information from the input–output analysis is refined in the fourth step in combination with external information from existing value chain maps or clusters. This allows us to create value-chain specific concordance tables that link the sectors of the input–output tables to the Vietnam Standard Industrial Classification (VSIC) codes. Note that these concordance tables are value chain specific, as the input–output tables are much more aggregated than the 5-digit VSIC codes (138 sectors vs. 734 sectors), that is, an I/O sector can be linked to different VSIC codes. VSIC is crucial to ensure accurate reference of value chain structure and reliable source of analytical data.

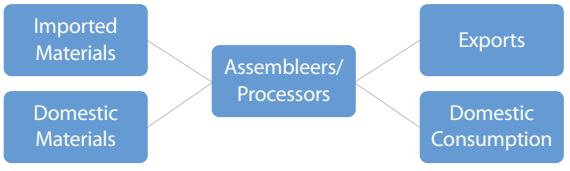
Defining spatial structure of value chains

The *third step* is to use the analytical results of the above analysis on input–output linkages of the domestic value chains to determine their spatial structure. In other words, the main purpose of this step is to determine geographical distribution and industrial concentration of selected chains, including the backward segments of the value chain. Spatial structure of value chains is defined as the concentration of employment in each segment of a given value chain.

Value chain-based connective propensity and key corridors

A connective propensity for a value chain is defined as the trend of related commodities flowing from and to international gateways and along various productive points of a domestic value chain, as shown in the connective model in figure A.2. A connective propensity is defined based on spatial locations of different productive segments of the domestic value chain and the structure of value chain linkages. It is started with imported materials from a gateway of import, connecting to through various intermediate points of supplying and processing raw materials, and finished products to ultimately gateways of exports or domestic consumption places.

FIGURE A.2. **Connective Model for a Value Chain**



Transport distance is assumed to define priority of movement of goods and transport corridor formation.

In this model, an import–export gateway lies at the end of the nodes. For all identified value chains, trade gateways—air, sea, inland waterways, rail and road—are origins of imports and destinations of exports, while in contrast, the location of cluster segments (suppliers and processors) is the internal export origin and import destination. The information on trade gateways and border gates in all transport forms are important for value-chain based connectivity.

This analytical step should be completed by a modeling of the value chain linkage as a result of the previous study. This will simulate the freight flows in accordance with origin–destination model along the spatial organization of value chains and connects chains to main international gateways. The mapping results allowed to identify trade corridors organized to promote value chain linkages, and to evaluate supporting logistics services to improve overall efficiency as well as the competitiveness of selected value chains. An important step involves developing a model of disaggregated freight flows for traffic between the main freight centers in Vietnam (at district level if possible, including cluster locations) and the country's trade gateways. The freight flows modeling, however, requires data concerning the volume of freights for input–output transportation within a value chain and between processor location and border gate. Given the lack of readily accessible volume data required for relevant freight flows, available trade HS value data should be converted into equivalent freight volume data. Proven techniques to convert the value of exports and imports of commodities will be used with appropriate assumptions. The key challenge is the lack of provincial input-output tables to define linkages and origin–destination flows per commodity within value chain of each of selected clusters.

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Methodology: Estimation of Off-Farm Wage Participation and Wage Earnings Differences

Market access and off-farm wage employment

The standard farm household model (Singh, Squire, and Strauss 1986) is applied in this analysis, incorporating insights from the life-cycle theory of labor supply (MaCurdy 1981), to explain the observed off-farm labor participation decision. The farm household model maximizes utility from household total consumption and leisure of the members, given the individual and household characteristics under budget and time constraints. The model takes the following form:

$$\text{Max } U(C_h, L_i; A_i, B_h)$$

$$i = \text{head, spouse, eldest child}$$

$$\text{s.t.}$$

$$Q_h = f(T_i^f, H_h; A_i, F_h)$$

$$C_h + RH_h \leq PQ_h + \sum W_i^a T_i^a + \sum W_i^{na} T_i^{na} + Z_h$$

$$W_i^{na} = W_i^{na}(A^i, M^{na})$$

$$W_i^a = W_i^a(A_i, M^a)$$

$$T_i = T_i^f + T_i^a + T_i^{na} + L_i$$

$$L_i > 0$$

$$T_i^f, T_i^a, T_i^{na} \geq 0 \qquad (1)$$

where U is the utility function for household h; C_h is the total household consumption; L_i is leisure time for family member i, where i can be head, spouse, and the eldest child;[1] A_i is a vector of individual attributes; B_h is a vector of household attributes; Q is the quantity of farm output, determined by a production function f with family labor input T_i^f, hired inputs H_h, subject to individual attributes (A_i) and household attributes (F_h); R is the price of hired inputs; P is the price of farm output; W_i^a is the wage rate for wage employment in the agricultural sector; T_i^a is time devoted to the agricultural wage employment; W_i^{na} is the wage rate for non-agricultural wage employment; T_i^{na} is the time devoted to the non-agricultural wage employment; Z_h is non-labor income, which includes capital income and transfer income.

Wage rates are a function of individual attributes and local labor market conditions in the non-agricultural sector, denoted by M^{na}, and in the agricultural sector, denoted by M^a. The time constraint is such that the sum of family labor input, wage employment in the agricultural sector and non-agricultural sector, and leisure is equal to the total time available, denoted by T_i; nonnegativity constraints are

imposed to allow for nonparticipation in the labor markets. By solving the Kuhn-Tucker conditions, labor participation decisions are determined by a set of condition in (2) where $P\frac{\partial Q_h}{\partial T_i^f}$ is the marginal value of farm products; $\frac{\partial U}{\partial L_i}$ is the marginal utility of leisure; γ is the marginal utility of income:

$$P\frac{\partial Q_h}{\partial T_i^f} \le \frac{\partial U}{\partial L_i}/\gamma; \quad W^a{}_i \le \frac{\partial U}{\partial L_i}/\gamma; \quad W_i^{na} \le \frac{\partial U}{\partial L_i}/\gamma \qquad (2)$$

The allocation of work for household members is obtained by comparing the marginal value of farm products and wage rates with the reservation wages, which are the MRS between leisure and income evaluated at zero labor hours in the respective labor activities. As a result, reservation wages for each labor activity are inter-related. For example, the reservation wage for non-agricultural labor supply is evaluated at zero non-agricultural labor activity, which means that all time endowment is devoted to household farm or agricultural wage activities. When the marginal value of farm products or market wages exceed the reservation wages, the individual will participate in the labor activities. The reduced-form extensive margins can be illustrated as the following equations, 3(a) through 3(c):

$$\text{Prob}(Y_i^f = 1) = \text{Prob}(P\partial Q_h/\partial T_i^f - W_i^{(f*)} > 0) \qquad (3a)$$

$$\text{Prob}(Y_i^a = 1) = \text{Prob}(W_i^a - W_i^{(a*)} > 0) \qquad (3b)$$

$$\text{Prob}(Y_i^{na} = 1) = \text{Prob}(W_i^{na} - W_i^{(na*)} > 0) \qquad (3c)$$

where Y_i^f, Y_i^a, and Y_i^{na} represent the extensive margins of household farm labor, agricultural wage employment, and non-agricultural wage employment; $W_i^{(f*)}$, $W_i^{(a*)}$, and $W_i^{(na*)}$ are the reservation wages for the respective labor activities. The reservation wages are unobserved, so are the market wages for those unemployed. To arrive at a set of estimable reduced-form labor participation equations, the reservation wages are modeled by a function of the observed individual-level, household-level, local community-level characteristics, and individual random effects in the following equations 4(a) through 4(c):

$$\text{Prob}(Y_i^f = 1) = \text{Prob}(P\partial Q_h/\partial T_i^f - W_i^{(f*)} > 0)$$

$$= \text{Prob}(P\partial Q_h/\partial T_i^f - W_i^{(f*)}(A_i, B_h, F_h, M^{na}, M^a) - \varepsilon\_i > 0) \qquad (4a)$$

$$\text{Prob}(Y_i^a = 1) = \text{Prob}(W_i^a - W_i^{(a*)} > 0)$$

$$= \text{Prob}(W_i^a(A_i, M^a) - W_i^{(a*)}(A_i, B^h, F_h, M^{na}, M^a) - \varepsilon\_i > 0) \qquad (4b)$$

$$\text{Prob}(Y_i^{na} = 1) = \text{Prob}(W_i^{na} - W_i^{(na*)} > 0)$$

$$= \text{Prob}(W_i^{na}(A_i, M^{na}) - W_i^{(na*)}(A_i, B_h, F_h, M^{na}, M^a) - \varepsilon\_i > 0) \qquad (4c)$$

where ε_i is the individual random effect. In this analysis, we focus on non-agricultural wage employment. By assuming ε_i is normally distributed, we arrive at the following probit model for non-agricultural labor participation for household head, spouse, and the eldest child:

$$\text{Prob}(Y_i^{na} = 1) = \text{Probit}(A_i, B_h, F_h, M^{na}, M^a) \qquad (5)$$

As labor supply decisions are determined collectively within the household, it is not reasonable to assume that ε_i is independently distributed among the household head, spouse, and the eldest child. To cope with the serial correlation within the household, we use a multivariate probit model (Benjamin and Kimhi 2006) to jointly estimate the non-agricultural wage employment participation decisions.

We found two limitations in this analysis. The first limitation relates to the internal validity of the probit estimates. Given that the purpose of this analysis is to document the correlates of non-agricultural wage employment at various levels, we assume that the individual random effects are uncorrelated with A_i, B_h, F_h, M^{na}, and M^a. To the extent that this assumption is violated, we have limited internal validity of the estimates. Panel data strategies, such as fixed-effects models, can potentially control for this endogeneity. However, the rotating panels of Vietnam Household Living Standards Surveys (VHLSSs) conducted by the General Statistics Office (GSO) in previous years (2012 and 2014) result in small samples that do not provide enough statistical power to estimate the multivariate probit model. The second limitation concerns the external validity due to sample selection. To estimate the multivariate probit model, we need to select the households that have at least one co-residing, working-age child. However, living arrangement is not random. If the unobserved household-specific variables that determine living arrangement also affect non-agricultural wage employment, then we have restricted external validity to apply the results from this analysis to the rest of rural Vietnamese households. We solve this by estimating a household and spouse model, which covers a broader set of households. The findings are qualitatively similar.

To estimate the multivariate probit model, we use a sample of 4,257 rural households with 12,771 individuals from the VHLSS in 2016. This nationally representative survey includes detailed information at the individual, household and commune levels. Within each household, we keep only the household head, the spouse, and the eldest child for the first model, or only the household and spouse for the second model. All individuals are in the prime age range between 15 and 64 years old, and are not currently attending school. The results are shown in table A.2.

Market access and spatial wage differences

Most of the empirical analysis of the relationship between market access and the spatial variation in wages estimate the relationship using regional average wages instead of individual wages. In this study, we follow Hering and Poncet (2010) to estimate the relationship between market access and wage variation, controlling for individual characteristics such as education, which is an important determinant of earnings. This is particularly important in the context of Vietnam where lagging regions have a higher share of less educated people when compared to the country's agglomeration centers. A typical Mincerian earnings regression is estimated with individual hourly wages as the dependent variable. The analysis is done with the VHLSS 2016 data, using observations in both rural and urban areas.

The new economic geography literature emphasizes that lower transportation costs faced by firms in locations with higher market access allows these firms to pay higher wages, thus explaining the positive relationship between market access and higher wages. Since market access is linked to agglomeration, others have proposed alternative mechanisms relying on agglomeration economics

to explain the observed impact of market access on wages. Dekle and Eaton (1999) for example, point out that greater demand pushes up the price of land in agglomeration centers, inducing firms to raise nominal wages to maintain workers' purchasing power. Hanson (2003) also distinguishes other mechanisms, such as the presence of non-human factor endowments and increasing returns due to spillovers between firms and/or human externalities. As a result, Combes, Duranton, and Gobillon (2008) emphasize skills sorting in explaining the positive relationship between market access and wages, while Head and Mayer (2006) showed that failure to control for educational differences in the analysis of regional wage differences runs the risk of incorrectly attributing spatial wage disparities to economic geography factors.

To distinguish the impact of market access through the transportation costs links, the model estimates controls for (a) the skill intensity of each location using the share of people with post-secondary education, (b) land values and the local population density to capture the impact of agglomeration on the cost of living (housing, transportation costs, and congestion), and (c) provincial fixed effects to control for non-human factor endowments. This is addition to standard variables in earnings regressions, like type of firm, occupation and sector. The results are shown in table A.3.

TABLE A.2. **Determinants of Off-Farm Wage Participation**

Variables	Model 1			Model 2	
	Head	Spouse	Child	Head	Spouse
Male	0.355***	0.624***	−0.0844*	0.284***	0.625***
Age	0.0422	0.0132	0.102***	0.0365***	0.0644***
Age squared	−0.000795*	−0.0006	−0.00191***	−0.000737***	−0.00121***
Highest education – primary	−0.0963*	−0.162**	−0.374***	−0.115***	−0.203***
Highest education – low secondary	0.067	−0.0133	−0.307***	−0.0308	−0.136***
Highest education – high secondary	0.192**	−0.0904	−0.203***	0.00934	−0.0397
Highest education – tertiary	1.275***	1.713***	0.427***	1.225***	1.664***
Married			−0.246***	−0.789	3.848
Participate in women's group	−0.0646	0.00365	−0.0959	−0.0634	0.00443
Have communist family	−0.169	−0.393***	−0.131*	−0.0307	−0.242***
Have veteran family	−0.201	0.0354	−0.0553	0.0335	0.0184
Migrated from other provinces	0.0601	0.0696	−0.0388	0.00981	0.0951**
Injured in the past year	−0.0645	−0.118	0.0211	−0.0311	0.00282
Have dwelling ownership	−0.455*	−0.502*	−0.332	−0.229**	−0.164*
Support program – input	0.0323	−0.197	0.182	0.0483	0.134
Support program – credit	−0.307	−4.144	−1.054	0.013	−0.54
Support program – ag extension	0.236	−4.029	−0.254	0.354*	−0.319
Share of children age 0~5	0.0805	−1.037**	0.305	−0.134	−0.387**
Share of elderly age 70 and above	2.386	4.507	2.253	−1.364	0.559

TABLE A.2. **Continued**

Variables	Model 1			Model 2	
	Head	Spouse	Child	Head	Spouse
Z score of non-labor income	−0.0158	−0.0438	−0.032	−0.0496***	−0.0453**
Ethnic minority	−0.251***	−0.155	−0.280***	−0.154***	−0.166***
Log of crop price index	−0.112***	−0.0983***	−0.0564***	−0.111***	−0.0824***
Grows rice	0.114**	−0.0754	0.0648	0.121***	−0.0255
Grows other annual crops	−0.0309	−0.157***	0.0661	0.0287	−0.158***
Grows industrial crops	−0.0152	−0.11	−0.162***	−0.0141	−0.142***
Grows fruit trees	−0.289***	−0.285***	−0.0801	−0.295***	−0.299***
Raises livestock	−0.0292	−0.190***	0.0807*	−0.0619**	−0.190***
Market access index	0.106***	0.147***	0.194***	0.122***	0.227***
Log of population density	0.0778***	0.126***	0.137***	0.104***	0.134***
Agricultural share increases	−0.0599	0.023	−0.0478	−0.0443*	−0.0520*
Coastal commune	−0.101	0.0844	0.0242	−0.147**	−0.0853
Inland delta commune	0.154	0.0301	0.253***	0.0931*	0.0272
Hill commune	0.152	0.125	0.412***	0.264***	0.105
Low mountain commune	0.157*	0.0603	0.181**	0.154***	0.133**
Number of natural disasters	0.00628	−0.0011	−0.017	0.00857	0.00288
Log of non-ag wage versus ag wage ratio	−0.108	0.115	−0.326***	−0.106*	−0.0471
Have ag-extension center in commune	0.146	0.0368	0.0108	0.0186	−0.016
Have markets in commune	−0.0051	−0.0004	−0.034	−0.00717	0.000491
Have any education institutes	−0.425	0.0809	−0.0004	−0.326*	0.109
Have a private bank in the commune	−0.0639	−0.0331	−0.0007	−0.0764***	−0.0307
Firm opportunity nearby	0.123*	0.0599	0.108	0.0936**	0.0498
Share of manufacturing labor in commune	−0.0358	0.206	0.540***	0.157*	0.233**
Share of services labor in the commune	0.496	0.123	−0.18	0.918	0.536

Source: World Bank calculations from Vietnam Household Living Standards Survey (VHLSS) 2016, conducted by the GSO. See: https://www.gso.gov.vn/default_en.aspx?tabid=515&ItemID=18977.
Note: * = p<0.10, ** = p<0.05, *** = p<0.010.

TABLE A.3. **Determinants of Wage Earnings**

Variables	(1)	(2)
Individual characteristics		
Male	0.155***	0.153***
Experience	0.028***	0.029***
Experience sq	−0.000***	−0.000***
Years of education	0.026***	0.026***
Participate in women's group	−0.008	−0.011
Communist party membership	0.052***	0.054***
Has veteran family	0.002	−0.002
Ethnic Minority	−0.037**	−0.030*
Location characteristics		
MA index	0.030***	−0.015
Firm type interactions (Base = Domestic Private Firm)		
MA index * SOE	−0.067***	−0.061***
MA index * Foreign−invested	0.151***	0.131***
Log of population	0.021***	0.012**
Midlands and Northern Mountains	0.033**	−0.074**
Northern and Coastal Central	0.036**	−0.149***
Central Highlands	0.058***	−0.141***
Southeast	0.155***	0.108***
Mekong Delta	0.034***	−0.052
Medium housing value (million VND/square meter)	0.005***	0.003***
Share of people with post−secondary education	0.144***	0.194***
Urban	−0.031***	−0.030***
Province FE	No	Yes
Occupation FE	Yes	Yes
Industry FE	Yes	Yes
Inverse Mills Ratio	−0.02	−0.007
Observations	26064	26064
Adjusted R squared	0.220	0.231

Source: World Bank calculations from Vietnam Household Living Standards Survey (VHLSS) 2016, conducted by the GSO. See: https://www.gso.gov.vn/default_en.aspx?tabid=515&ItemID=18977.
Note: * = p<0.10; ** = p<0.05; *** = p<0.010.

NOTE

1. Ideally, we would like to include all members in the household, but for a simple illustration, we include only the eldest child in each household.

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Methodology: A General Equilibrium Model to Evaluate Transport Interventions

Recent research has developed quantitative models for the spatial distribution of economic activity (Redding and Rossi-Hansberg 2017). These models incorporate features of the data, such as large numbers of locations with heterogeneous geography, productivity, amenities, and local factors as well as trade and commuting costs. They are also able to include interactions between locations, such as trade in goods and migration. These models can be used to evaluate policies and counterfactual scenarios and to set apart the contribution of transport improvements versus other changes that affect wages and population across locations.

The models have three main building blocks:

- Geography. The model allows for spatial granularity at the district level considering the 683 districts of Vietnam. Each district is characterized by its location, land area, livability, economic structure, and firm productivity. Livability captures the quality of life in a district, which is determined by factors such as the quality of education and health services that influence people's choices on where to live.
- Economic activity. Firms undertake production by choosing the amount of output and inputs—labor and land—used in the production.
- Workers. Workers choose the sector in which to work and where to live. All workers derive their income from employment and spend it on goods and services produced locally or imported from the rest of the world. Workers' decisions on where to live and where to work depend on rents, wages, and livability across districts.

Using population, land, and transport data for 2009 and 1017, district productivities and amenities are calibrated to make counterfactual predictions. The information required to calibrate the model is similar to the one used in the calculation of market access and comes from traditional data sources, such as surveys and from geo-coded information on the transport network.

The calibration process relies on observed variables—size of land, employment per sector (second model) or wage (first model), and population density) to induce some key parameters that will encompass the unobserved characteristics of each district. Although productivity and livability scores at the district level are not observed, the model is used to infer these scores based on the observed levels of the size and composition of land, employment per sector, and population density. Productivity scores reflect the potential of firms to produce using labor and land inputs. While workers and land are similar across districts, the capacity of firms to produce differ across locations. Livability scores reflect the potential of a district in terms of amenity and affect the residential choice of workers. Workers tend to move toward districts offering higher real wages and higher amenity levels.

Data used to calibrate include land areas (European Space Agency land categories from the Aiddata database (http://www.aiddata.org), the current distribution of population per district from census data for 2010 and 2015, and employment and wage categories from the MTI survey datafound in unpublished survey data provided by the World Bank's Macroeconomics, Trade, and Investment Global Practice.

Model used to produce counterfactuals for domestic connectivity

Based on Redding (2016), the model can be used to undertake counterfactuals using only data in an initial equilibrium. In the counterfactuals, the welfare gains from trade depend on changes in both domestic trade shares and reallocations of population across locations. The model has constant returns to scale, with all districts potentially trading with one other. Some locations experience larger reductions in trade costs than others, and population reallocates to these locations and away from other locations until the price of the immobile factor of production land adjusts. However, some differences remain in real wages across districts.

Model used to produce counterfactuals for international connectivity

The spatial general equilibrium model for Vietnam assesses the effects of improved internal transport costs on the integration of districts with global markets. The model looks at how reductions in transport costs affect the competitiveness of districts in the production of imports and exports—that is, tradeable goods. The model relies on previous work done for Bangladesh,[1] Argentina (Fajgelbaum and Redding 2018) and for the Belt and Road Initiative in Central Asia (Lall and Lebrand 2019). Similar to the previous section, the model has three main building blocks—geography, economic activity, and workers—which are connected by goods prices, land rents, and wages that prevail in each district.

NOTE

1. Bangladesh work detailed in an unpublished 2019 World Bank background paper based on this report, written by Mattias Herrara-Dappe and Mathilde Lebrand.

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Appendix B: Value-Chain Critical Transport Corridors

In chapter 2, we presented the results of the analysis on the aquaculture value chain and the aggregate map showing all value-chain critical transport corridors. Figures B.1 through B.5 present the critical transport corridors for other significant value chains, including coffee, rice, rubber, textiles and garments, and vegetables and fruits.

FIGURE B.1. **Value Chain Critical Transport Network: Coffee**

FIGURE B.2. **Value Chain Critical Transport Network: Rice**

FIGURE B.3. **Value Chain Critical Transport Network: Rubber**

FIGURE B.4. **Value Chain Critical Transport Network: Textiles and Garments**

FIGURE B.5. **Value Chain Critical Transport Network: Vegetables and Fruits**

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