Metro Freight:
The Global Goods Trade that Moves Metro Economies

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"Goods trade delivers unquestionable returns to metropolitan economies, making it imperative that metropolitan leaders understand how their economic base relates to current and prospective trade partners."

Summary

One of the lessons from the Great Recession is the need to grow and support the tradable sectors, typically manufacturing and high-end services, of our metropolitan economies. But to drive these tradable sectors, metropolitan areas need physical access to markets. Metropolitan freight connectivity enables this access and the ensuing modern global value chains. Without it, trade cannot occur.

This report establishes the economic rationale for metropolitan goods trade, describing why, how, and what these areas exchange with each other. It makes these key points:

- **Metropolitan economies cannot function unless they trade goods with one another.** Land, labor, and capital limit what a metropolitan area can produce on its own, meaning goods trade is essential to deliver economic benefits to metropolitan economies. If economic benefits compel metropolitan areas to trade, then transportation makes those benefits a reality.
- **Recent global trends make domestic and international trade more prevalent and more competitive than ever.** Major innovations of the 20th century—freight technologies like expanded shipping capacity, new logistics resources, and communications infrastructure like broadband—reduced the costs of trading goods within and among different countries. At the same time, national governments liberalized trade through barrier reductions like free trade agreements. These forces helped global merchandise volumes reach $18.3 trillion in 2012, an increase of over 400 percent since 1990. In the process, trade effectively reduced the distance between markets, expanding domestic and global competition over firms' production costs, limited energy resources, and overall market power.
- **The rise of global value chains forces metropolitan areas to assess their relationship to the global economy.** Goods production is no longer dominated by single production lines concentrated in one country. Emerging markets are now major participants in global value chains, meaning value creation occurs in multiple locations, through various firms, and typically spans manufacturing and service industries.
- **To maximize trade's economic returns, metropolitan areas need a firm understanding of their economic position as well as a supportive policy framework.** To do that, metro leaders need to understand global trading networks. They also must recognize the importance of transportation assets—both within their region and beyond—to enable trade. Unfortunately, current trade measures and public policies are either limited to national indicators or omit most metropolitan areas, obscuring domestic trade networks in the process. Today in the United States there is no national freight strategy, and most metropolitan areas fail to implement comprehensive trade strategies.

The long-term goal of this series is to inform a new model of freight policy and practice where public and private leaders work in concert to create a more favorable trade environment for the American economy. Through a series of statistical surveys, it will offer policymakers and the private sector a toolkit to map and analyze goods trade in the 21st century. This paper is the first step in that process: establishing the foundational importance of goods trade to metropolitan economic health and vitality.

I. Introduction

Metropolitan Houston is a U.S. economic dynamo. While the country struggled to regain its footing following the Great Recession, Houston charted a different, more prosperous path. The metropolitan economy only took nine months to resume growth following its local recession and since has grown an additional 15 percent in less than five years.[1] Houston's employment picture is appreciably better than the rest of the United States with a net increase in jobs since the recession and an unemployment rate of 6 percent.

Behind this success story is a productive metropolitan economy that still makes things. Nearly 20 percent of Houston's economic output is derived from manufacturing.[2] Specializing in chemicals and machinery, its manufacturing sector is a larger share of its metropolitan economy than traditional industrial hubs such as Pittsburgh and Detroit.[3] Houston's mining industry is also a major metropolitan growth engine. Powered by both oil refineries and corporate headquarters, mining generates over 16 percent of Houston's metropolitan output.[4] Taken together, these industries represent over one-third of the Houston economy.[5]

While these industries deliver economic benefits to Houston, they also rely on trading partners outside the region. Fortunately, the region has a full set of freight transportation assets, including ports with deep water access, thousands of miles of limited access freeways, two major airports, and strong rail and intermodal connectivity to physically connect with other markets around the nation and world.

The region's freight network of course operates twofold by bringing in the products Houston cannot live without. For example, the region's agriculture and forestry industries are relatively tiny.[6] Without bringing in those products from elsewhere, Houston would not have food to feed its residents or lumber to build houses. Along the same lines, Houston manufactures only small amounts of textile-related products.[7] Inflows are equally important here, providing clothing for residents and textiles for various industries.

From Houston to Hamburg, the story is the same: Freight transportation facilitates metropolitan trade and supports economic development.

This is amplified in an era of rapidly changing global goods trade networks that have the power to reconfigure the sites of economic dynamism. Public policy has a responsibility to recognize this vital relationship between economies and freight, and it is imperative that national policies reflect the domestic and global environments in which metropolitan areas must now compete.

This report advances a simple proposition: Because metropolitan economies cannot function unless they trade with each other, and because trade cannot occur without freight transportation networks, freight and economic development policies and practices must be coordinated and globally focused. In the process, it stresses the importance of considering trade at the critical sites of consumption, production, and goods movement: metropolitan areas. The report proceeds in three parts:

- It establishes the economic rationale for why metropolitan areas trade goods, why certain metropolitan areas trade with each other, what goods metropolitan pairs sell to one another, and the transportation infrastructure that makes it all possible.
- It describes the modern global trade environment, the creation of global value chains, and the implications of both on modern metropolitan trade relationships.
- It concludes by outlining the failures in current freight and economic policies to accurately capture the scope and power of modern trade networks.

This report also begins a new series that will explore the relationships between goods trade, freight transportation, and metropolitan economic growth. Each of these areas of policy and practice are complex, but global competition in the 21st century forces leaders at all levels to craft an economic agenda that considers them in concert. The goal is to provide leaders with a framework to facilitate that agenda-building—and this report serves as the foundation.

Why Metropolitan Areas?

This paper eschews typical national-level trade analyses to focus on the world's primary economic units, metropolitan areas. In the simplest of terms, a metropolitan area is a regional economy. It is the network of cities, towns, and villages whose residents and businesses interact with one another on a daily basis, typically expressed through a common labor market and shared commuting patterns.[8] They tend to have common cultural institutions, and other shared social characteristics. Just as importantly, metropolitan areas are defined by their networks of civic leaders who guide the economic future of their region.[9]

Within the United States, metropolitan areas dominate national-level economic performance, with the largest 100 regions generating three-quarters of national economic output, as measured by gross domestic product (GDP).[10] The same 100 metro areas also contribute disproportionately to almost all key indicators of economic health.[11] This includes many of the drivers of a production-led economy, from 90 percent of advanced industrial jobs to 92 percent of patents.[12]

These large population and economic centers are also home to the country's chief freight transportation assets. From New Orleans and Houston to New York and Los Angeles, 14 of the country's 20 busiest seaports are in the 100 largest metro areas.[13] In the growing need to move high-value, low-weight products, these 100 metros are also home to nine of the country's 10 busiest airports by total cargo value.[14] More than 2,020 of the nation's 3,280 intermodal facilities are also found in these 100 metro areas, critical for transferring freight across multiple modes.[15] Finally, these metro areas accounted for over 64 percent of all highway and major road traffic in the United States, helping to move freight and workers within and between these markets.[16]

Considering their economic primacy, this series uses metropolitan areas as the primary lens to assess goods trade. In forthcoming papers, it will introduce new metrics demonstrating the heavy role metropolitan economies play in global goods trade.

Key Terms

Trade: The exchange of a good or service between two distinct metropolitan areas, also known as *intermetropolitan trade*. The term includes the exchange of goods or services between domestic metropolitan areas, meaning the paper will specify when referencing *international trade*.

Goods Trade: The physical exchange of products or commodities between two distinct trading partners. These exchanges encompass the full range of commodities, from the rawest natural resources like stones to the most advanced products like aerospace equipment.

Inflows: The volume of goods a region or metro area purchases from other places, reported in either value or weight. Inflows are subdivided domestically (by domestic destination) and internationally (by foreign origin). "Imports," as such, refer exclusively to international inflows.

Outflows: The volume of goods a region sells to other regions and countries, reported in either value or weight. Outflows are subdivided domestically (by domestic origin) and internationally (by foreign destination). "Exports," as such, refer exclusively to international outflows.

Services Trade: The exchange of a service between two distinct trading partners. Unlike goods trade, no physical product changes hands. A classic example is financial services, like banking or market trading, which can be conducted in one place but sold to a consumer in another market.

Production: The act of creating a good or service. The geographic location producing the good or service is considered the outflow producer in any external trading relationship. However, it is important to note that not all production leads to trade—some goods and services are consumed locally.

II. The Economic Rationale for Goods Trade

Why Metropolitan Areas Trade Goods

Land, labor, and capital are the most fundamental inputs allowing regional economies to produce goods.[17] In the course of this production, every metropolitan area will confront two issues. First, not all commodities and economic inputs exist within every metropolitan economy. Second, even when they do exist, they are always limited. There are only so many natural resources within a given area, only so many people to employ within a given market, and only so many human-made products available to use.

This combination of missing and limited inputs requires firms to look beyond their metropolitan borders to acquire the goods necessary to build new products, power their homes and factories, and determine what goods they can more cheaply buy from someone else.

Goods trade is the exchange of physical products. It is fundamental to the modern economies in which we participate.[18] Without goods trade, communities would be forced to subsist solely on what it could produce from local inputs, whether they be raw materials or manufactured products. Goods trade allows markets to compare their own inputs and products to what is available among all of their trading peers.

Inflows bring new or higher-value products to a community. New York purchases oil refined outside New Orleans, providing fuel for its vehicles and inputs for its chemical plants. Los Angeles purchases computer processors from facilities in Phoenix, enabling industries like film and television to add editing and post-production effects. Even if local products do exist, inflows can offer cheaper alternatives that save consumers money and push local producers to innovate more. In each case, inflows allow local markets to either consume or create products that would not be possible without a trading relationship.

Outflows bring financial assets to a community. By selling surpluses of a product—say those computer processors in Phoenix—the money spent by the purchasers moves to the seller's local or ownership market in the form of company profits and worker wages. Firms and consumers spend this revenue on a host of activities, from investment in new production inputs like warehouse space, to tradable services like financial investments, to locally consumed services like food, education, and healthcare. Outflows also have the power to improve public resources, since increased sales often deliver higher tax revenues. In all cases, this economic recycling continues through multiple stages—helping fund services that are inherently local and providing the financing to purchase inflows from other markets.

While each market will vary in its ratio of inflows to outflows, each form of goods trade is vital for metropolitan economic health.

Which Metropolitan Areas Trade Goods

Economic theory explains why trade occurs based on the value it brings to trading communities. But what determines which metropolitan areas will form a goods trading relationship?

Goods trade can only exist between two metropolitan areas when the products supplied by one market's firms meet the demands of another market's firms or consumers. Economic geography defines this as **complementarity** between markets.[19] While introduced in prior decades, complementarity became a foundational concept following Edward Ullman's seminal work in the 1950s.[20] Ullman and his peers argue that the existence of matching supply and demand, much like a business and its customers, is the most fundamental method to determine if two places will share a geographic product exchange. As forces change—rising demand in one market, a new supply in another—complementarity will shift.[21] Consider Pittsburgh's famous steel mills and the New York City building boom during the early twentieth century. Those early skyscrapers all required steel beams, creating a complementary relationship between Pittsburgh's steel suppliers and New York City's construction demands.

Complementarity may be a requirement in any trading relationship, but it is only one determinant. Ullman and other theorists define two other elements necessary to forge a trade relationship.

The first is **transferability**, which refers to the physical ability and cost to exchange goods. Physical connections can take many forms. They include roadways and railways over land, seaports and airports, even telecommunications infrastructure like phone lines and digital cables crisscrossing the

globe. Depending on the product being traded, any and all of these infrastructure investments are necessary to actualize complementarity. Without them, a region would stand in isolation and only consume what it can locally produce. However, since infrastructure connects almost every part of the world, costs are now the primary element defining transferability. As costs to move products rise, whether measured by money or time friction increases between places and reduces transferability. Conversely, lowering exchange costs can reduce friction and improve transferability.

Transferability even has the power to change complementarity in the long-run. Accessibility related to transportation costs will drive investment decisions, sometimes determining whether a company invests in a new facility in one market versus another. Economists like Paul Krugman and Edward Glaeser use this element in their discussion of scale economies driving locational investments, such as manufacturing clusters locating near large population centers to reduce their transport costs (and thereby improve transferability) and the ability to attract human capital.[22] Similarly, geographer Donald Janelle finds improvements in transportation connectivity and travel times can enhance a region's ability to attract new economic activity.[23] This entrance of transportation costs into industry's geographic decision-making can have long-run impacts on what a particular market has to supply and what input goods it will demand.[24]

The second determinant is **intervening opportunities**, which are the alternatives to a specific complementary relationship. Very few products are supplied by only one firm located in a single market; instead, businesses and consumers can choose from multiple firms in multiple markets all making either the same or virtually indistinguishable products. Similarly, more than one market generally will demand a certain product. The typical trade environment contains consumers and suppliers that both confront trading choices—in other words, multiple instances of complementarity.[25] Considering the previous Pittsburgh-New York City example, the emergence of steel mills in places like Allentown and skyscrapers in Chicago functioned as intervening opportunities.

It is important to note how intrafirm trading relationships follow this same rubric. For the large number of firms that maintain facilities in multiple metropolitan areas, their need to exchange products at different stages of production will generate trade between two markets. Consider the example of Phoenix selling computer processors to Los Angeles. Presume that an exchange between Portland's Intel Corp. and Phoenix preceded that exchange—Intel fabricates certain computer chips in Portland, of which some may by assembled and tested in Phoenix—driven entirely by Intel's own production lines and site selection process. These kind of intrafirm trades follow the same three basic trade determinants—supply from one facility meets the demands of another, the sites must be physically connected, and they are the optimal sites to conduct the trade—but firm leadership makes decisions in a more centralized manner rather than trades between different firms in different metropolitan areas.

What Types of Goods Metropolitan Areas Trade

As previously mentioned, the core economic components of any market are its land, labor, and capital. Those factors of production are limited within each market, and that scarcity drives metropolitan areas' firms and consumers to trade for what is unavailable at home. Conversely, a metropolitan area's local production inputs and the quantities available of each determine what a region can produce on its own.

Just like the varied distribution of factors of productions, each metro area will vary in its local production potential. Some locations will leverage their natural resources, say coal in Wyoming or citrus in Florida. Manufacturing centers will have surpluses from their production lines, such as airplanes in Wichita and cars in Detroit. Whether measured by weight or value, each metropolitan area should sell more of these particular products than it purchases, also known as a surplus **trade balance**. Trade balances are often reported at the national level—oil from Saudi Arabia, electronics from Korea—but they also exist at the metropolitan scale.

Assessing all local industry types—goods producers, tradable services, local services, even private consumers—will create an inventory of what goods the metropolitan area has to sell and what goods it needs to buy. In this sense, local industrial and population composition is the key indicator of what goods a metropolitan area will trade.

Economists have recognized this relationship between local production, local consumption, and goods trade for over a century. Stretching from the early work of classical economists like Francois

Quensay, geographic economists like Walter Isard, and especially 1973 Nobel Prize winner Wassily Leontief, economists developed and upgraded models to capture the goods movement and interdependencies that exist based on local economic composition.[26] They eventually came to be known as **input-output models**. The models are complex to produce, but the outputs are easy to read: a list of expected consumption (input) and production (output) commodities for each industry. Their utility at all levels of economic analysis boils down to their ability to translate economic composition into a commodity-based mathematical equation, where input commodities plus local labor create outputs.

By creating a link between outputs and inputs at the industry level, models are also a powerful tool in understanding the economic foundation behind the **interdependent trading relationships** established throughout the world.[27] By specifying each industry's product inputs and outputs, the models enable a geographic matching exercise between production and consumption to either verify current trading relationships or where potential relationships exits. In essence, such an exercise can help measure expected complementarity against actual complementarity.[28]

How Metropolitan Areas Trade Goods

The previous trade fundamentals—the *what, where,* and *why*—define the economic rationale behind the trade of goods. That leaves one final consideration—*how* to make goods trading relationships a reality. That is the role of freight transportation.

In the simplest terms, freight transportation is the movement of goods between destinations. But freight transportation is much more than just putting a box on the back of a truck, or loading lumber onto a river barge. At its core, freight transportation is the matching of production and consumption, the actualization of supply meeting demand. It is the physical manifestation of the complementarity principle.

Freight transportation's role as the matchmaker between production and consumption, and the difficulties associated with that exercise, has always been a fundamental part of metropolitan economic growth. For example, major cities of the Third century B.C. like Alexandria and Seleucia grew due to their seaborne access, trade network connectivity, and the military power to control transportation flows.[29]

Technical innovations have always had an incredibly important role in improving access between markets—the compass in the 11th century canals greatly reduced costs versus roads, and the steam engine and railways brought similar price drops and travel time improvements to markets far from natural water. All the while, these innovations created the need for financial and management centers, boosting primary seats of commerce—such as New York, Amsterdam, and London.[30]

The 20th century's freight innovations further enhanced trade. Introduction of the standard shipping container added assembly line-style efficiency to seaborne trade and port-side movements.[31] Trucking inspired significant roadway investments, enabling U.S. highway freight movements to grow from 173 billion ton-miles in 1950 to over 1 trillion in 2000.[32] The airplane dramatically reduced global shipment times, especially for high-value, low-weight products.

Tying these modern innovations together was the growth in logistics and the effective management of physical resource flows. Clear communication of inventories, supply needs, and customer requests helped coordinate the movement of freight transportation assets between manufacturing plants, warehouses, and final customers.

Today, advanced manufacturing centers plan their days around a consistent stream of daily deliveries and pickups, built on a foundation of global logistics certainty. Some households can plan meals around any fruits and vegetables they please, regardless of season or global geography. Online retailers bring the consumer products of the world to many doorsteps, transforming an internet connection into the biggest marketplace humanity has ever seen. In a world of such expectations, freight transportation is the great enabler.

These trade fundamentals—the why, where, what, and how—serve as the backbone of any metropolitan area's goods trading relationship. Yet these fundamentals are only an initial guide. In practice, every trading relationship is unique based on the variable trade partners, the exact products exchanging hands, and the transportation methods chosen. The next section will explore the dynamic changes afoot in global commerce.

The Memphis Logistics Hub and Future Economic Growth

Memphis is one of the world's largest freight hubs. With ready access to metros across the Eastern and Central time zones, Memphis steadily strengthened its logistical presence by investing in key infrastructure assets and expanding its economic base to serve a global network of consumers and producers. However, Memphis' freight and logistical focus leaves even more opportunities for those transportation activities to contribute to the metropolitan area's long-term economic growth.

Among its infrastructure assets, Memphis stands at the intersection of five major freight railroads and two interstate highways, cycling high volumes of goods into and out of the area.[33] Its numerous bridge crossings, including the Hernando de Soto Bridge and the Harahan Bridge, provide vital links to origins and destinations across the Mississippi River. Memphis also contains the nation's fourth largest inland seaport, with handling facilities that cater to year-round traffic. Nearly 1,000 warehouses, 1,200 miles of pipeline, and 500 truck terminals further support this movement.

Memphis' airports are particularly valuable assets to the region. Owned and operated by the Memphis-Shelby County Airport Authority, Memphis International Airport boasts expansive cargo operating facilities, serving as the "Super Hub" for FedEx since the 1970s. Through the construction of additional runways and terminals, the airport has met rising air cargo demand, which has seen about a 5 percent annual increase since 1987, and supported the growth of FedEx, which now processes more than 3 million packages every day at its Memphis hub.[34] As a result, Memphis not only became the largest domestic air cargo hub by tonnage, moving almost 4 million tons of overall freight in 2010, but it also consistently ranks as one of the world's highest-trafficked freight airports.[35]

Since 1980, Memphis' economy grew faster than the national economy, supported in part by its logistics sector.[36] From 1980 to 2011, the metro's output increased by 138.5 percent in real terms, while its employment rose by 51.8 percent, higher than the figures for the nation (124.3 percent and 40.5 percent, respectively). The logistics sector accounted for 20 percent of this job growth, while FedEx alone made up about ten percent of the metro's total job growth. The sector also generated approximately 16 percent, or $8.6 billion, of the metro's total output, significantly higher than levels seen in most other industries and the highest output share related to logistics in any of the country's 100 largest metropolitan areas.

Memphis' high degree of specialization in logistics has given it a competitive edge in transportation, warehousing, and wholesale trade, but its leaders will need to continue exploring ways that broaden the region's economic base and build off existing infrastructure assets. Its reliance on FedEx, for instance, leaves it vulnerable to sudden fluctuations in market activity, while many of the occupations associated with logistics offer below-average wages.[37] For example, one-third of Memphis' logistics employment is categorized hand-labor, with below-average pay and minimum opportunities for advancement. The Great Recession dealt a heavy toll in this respect, as Memphis's total economic output fell by 5.6 percent from 2007 to 2010 and it has continued to rely on many of the same industries that have stagnated since then.[38]

By widening the scope of industries—and markets—it serves, Memphis can embrace a more dynamic freight strategy and explore additional opportunities for its logistics specialization to attract and grow goods-producing firms. This approach can help Memphis continue to capitalize on its strengths as a leader in global freight.

III. Today's Global Network

A combination of physical innovations and policy shifts, plus metropolitan economies' drive to enhance local economic growth, has pushed global trade to newfound heights.[39] Global goods export volumes reached $18.3 trillion in 2012, an increase of over 400 percent since 1990.[40] Just as importantly, global goods trade volumes have set new records every year for nearly three decades.

Heightened global interconnectivity forces metropolitan economies, and their national partners, to reconsider their advantages and disadvantages within today's global goods trade networks. This section addresses that need by further describing today's global goods trade environment, how production processes now extend beyond past geographic limitations, and what the implications of both are for metropolitan economies and freight transportation.

A Redefined Trade Environment

While the freight network modernized across modal and logistic channels, three key developments made the domestic and international trade environment easier than ever at the onset of the 21st century.

First, the world continues to dissolve international trade barriers. Traditionally, many countries instituted trade barriers to protect their domestic industries. Ranging from tariffs to outright trade bans to currency manipulation, trade barriers enhance the competitiveness of domestically-produced goods by either raising the relative costs of foreign goods or simply denying the sale of products. This stands in opposition to economists' calls for free trade—countries' ability to trade goods and services without tariffs, subsidies, or other artificial barriers—as a condition necessary to maximize trade's economic benefits.[41]

Whether motivated by economic theory, an endless search for lower costs, or some other combination of factors, countries and international law continue to move towards a freer global trade network. The World Trade Organization (WTO)—the primary organizational body responsible for regulating trade agreements and monitoring fair trade practices—grew from 82 members in 1973 to 159 in 2013, nearly doubling in 40 years.[42] WTO membership growth helped more countries trade freely, including broad regional agreements like the European Union, and reduce their tariffs and other trade barriers.[43] Many of these formal agreements and domestic policies permit, if not outright facilitate, foreign direct investment; such investment streams are critical for firms to enter new international markets.[44] Even specific industries maintain broad free trade agreements, such as the ever-growing Information Technology Agreement through the WTO. There is no question that the 21st century is the freest global trade period in modern history.

Second, telecommunications infrastructure and technology continue to improve, offering new opportunities to network across the world. From the 1800s telegraph to the 1900s telephone, disruptive improvements in information infrastructure unleashed new forms of trade coordination. The process continues today with digital cabling and wireless equipment. The internet now allows firms to exchange products like documents and data across continents in a matter of seconds, allowing just-in-time manufacturing, rapid-fire legal analysis, remote medical imaging analysis, and other business improvements. Firms can market their products across the globe, all from a central production studio in one location. Cellular phones permit voice communication around the globe, and increasingly offer data access. It is safe to say the transition to a more advanced industrial and service economy would be impossible without modern telecommunications.[45]

Third, freight innovations made shipping goods dramatically cheaper.[46] Over the course of the 20th century, innovations in transportation and logistics technology helped reduce shipping costs by 90 percent—meaning a far smaller share of GDP was required to transport goods. In the process, metropolitan areas lost their stranglehold on their regional markets, while those areas far from commodity centers could now more easily gain access to distant commodities for a competitive price. Shipping cost declines have stalled since the start of the 21st century due to a range of global developments, but the last century's freight innovations have left a lasting impact.

These distance-shrinking innovations actually expanded competition between economic regions.[47] In the past, limited trade geographies meant specific markets could control their regional or national

markets. If a single metropolitan area had a surplus of a certain product and its entire trade region was relatively isolated, they could exert market pricing power. Now with few isolated regions and global connectivity, possessing a production specialty is no longer enough—there are likely to be multiple regions across the country and world with the same specialty, and they may offer products at a lower cost. Such direct competition forces metropolitan economies to either match their peers or see their market power disappear.

The distance-shrinking specifically extends to firms making geographic decisions for their particular business lines. Since labor is relatively immobile but capital and technology are more mobile than ever, business lines with high labor cost shares will find lower-cost, emerging markets a more attractive production site. This is a key driving force behind industrial shifts to Asia's Pacific coast.[48] On the flip side, technology-intensive business lines or those that require certain knowledge assets will find high-cost, high-productivity labor more attractive. This is the current position for older developed markets like the United States and Western Europe. Such an intensely competitive market forces metropolitan areas to reassess their comparative advantages, taking into account a much farther-flung set of places than in the past.

A similar competition exists for energy. The rise of emerging economies like China and India, along with increases in global per capita income, lifted goods trade to record levels year after year—and all that trade requires more and more energy to move goods across the planet. Global demand for energy commodities like liquid fuels, natural gas, and coal increased by 43 percent between 1990 and 2008—and transportation continues to consume more energy than all other sectors combined.[49]

In the long-run, higher sustained energy costs have the power to recalibrate firms' location decisions—just like the comparisons between labor dynamics. As it stands, increasing demand and higher costs already inspired new energy innovations and research. From improved vehicle fuel efficiencies, to new mobile electric energy sources, to expanded natural resource extraction like natural gas, firms and nations are relentlessly seeking to reduce energy costs through a combination of energy efficiency and increased supply.

Brazil and the Changing Trade Environment

For decades, international trade barriers limited Brazil's ability to fully engage in global goods trade, despite abundant natural resources, plentiful labor, and an expansive industrial base. Historically, commodities ranging from copper and iron to coffee and sugarcane connected Brazil to markets around the world, but its economic policies restricted additional production and shipping activities over time.[50] The past two decades, however, have seen a rise in the nation's export-led growth, resulting from a reduction in trade barriers and an increase in foreign investment.

Indeed, after years of pursuing protectionist strategies, including tariffs and import substitution industrialization, Brazil's leaders adopted policies that integrated the nation into global value chains. As inflation peaked and production faltered in the early 1990s, President Fernando Henrique Cardoso introduced a new currency, the real, to stabilize the economy and paved the way for reforms that would privatize industry, promote free enterprise, and liberalize trade. Later policies like debt reductions, capital regulations, and other measures continue to heighten Brazil's competitiveness on the world stage.[51]

In response, Brazil's international trade boomed over the past twenty years. While extensive government protection – and debt – helped fuel Brazil's growth in the mid-20th century, a 515 percent increase in exports from 1990 to 2010 powered Brazil's modern "miracle" in industrial production, technological innovation, and global competitiveness.[52] Reaching almost $233 billion in 2010, Brazil's exports are principally derived from four key export sectors: mining and metallurgy, agribusiness, energy, and transportation equipment, all of which feeds demand in China, the United States, and elsewhere. Industrial centers, moreover, power this growth, including São Paulo which accounted for 33 percent of Brazil's GDP and 30 percent of its total exports in 2010.

However, despite reforms that lowered tariffs and opened trade, Brazil still has many obstacles in place that hinder investment and the free flow of goods. Brazil's tax regime is complex, for instance, adding extra time and pressure to conduct business relative to most other countries.[53] High interest rates, energy prices, and compliance costs also limit growth, recently sparking national protests.[54] In addition, forced localization measures aimed at protecting domestic manufacturers recently returned as a federal priority, limiting foreign competition and forcing countries to find alternate ways to invest in the Brazilian market.[55]

Perhaps most significantly, Brazil's underfunded and congested infrastructure struggles to handle the increased freight traffic associated with the country's growing trade, adding substantial costs to consumers and producers. For example, trucks move 60 percent of Brazil's freight, but 83 percent of its roads are classified as poor condition.[56] At the same time, Brazil's annual rate of infrastructure investment is only between 1 and 2 percent of its GDP, significantly lower than the 5 percent average among emerging markets.[57] Roads, rails, and ports, as a result, frequently lack the needed financial backing to facilitate goods movement. By one estimate, addressing these supply chain barriers could boost national output by over 3 percent.[58]

The Rise of Global Value Chains

Trade coordination can and often does occur across vast distances, meaning product markets stretch to every corner of the globe and metro areas can access the cheapest input and consumption products the world has to offer. The new reality is a global marketplace composed of interlocking trade networks. Those interdependent and expansionary trade markets created the modern-day global value chain.[59]

A global value chain (GVC) is the aggregation of individual production steps required to bring a product to market, and specifically captures the extensive geography, coordination, and integration necessary to make that entire process possible. This expansive look at the production process—including steps like "research and development, design, sourcing of inputs, the various stages of production, and marketing"—helps uncover how particular regions rely on one another to bring a consumable product to market.[60]

An example of this approach is the production process behind Apple's iPhone. The product is famously designed and engineered at Apple's headquarters in Silicon Valley. It also includes the well-known "Made in China" stamp on the back of the product box, signifying the final assembly conducted in Asia. GVC analysis includes these traditional bookend steps, but it also adds separate production steps like component manufacturing, such as the flash memory produced in Japan and the global positioning receiver sourced from Germany.[61]

GVCs are the new multi-step, multi-regional realities of the global goods marketplace. They symbolize an economic environment where a single firm or a network of contractors, suppliers, and manufacturers can coordinate complex production process in real-time across vast distances.

Although it used a slightly different name at the time, value chain theories developed in the late 1970s by Terrance Hopkins and Immanuel Wallerstein were the first to recognize growing global production chains. Those theories specifically focused on products' input and output processes and how they related to an expanded geography.[62] New research in the mid-1990s, led by Gary Gereffi, added a focus on the governance structures and institutions involved in commodity chains.[63] Governance and institutional analyses helped define where power resides in these multi-step production networks, whether through traditional elements like plant ownership or service-centers like corporate management. Academics continue to develop and diversify these chain theories, but each research strain shares the goal of capturing global interconnectivity via commodity production.

GVC theory helps contextualize regional relationships in the global economy. With metropolitan areas and their firms coordinating entire production lines over vast distances, understanding goods trade requires a dramatic and ongoing remapping of the world's supply chains.[64]

Goods production data stands as evidence of GVCs and their expanding geography.[65] First, global manufacturing is no longer dominated by developed markets. In 1970, the G7 countries generated roughly 70 percent of global manufacturing—by 2010 the share dropped to 46 percent. In its place emerging countries like China, Korea, and Turkey captured most of the difference. Second, a growing share of the world's goods production is sold for intermediary inputs rather than final usage. For example, by 2009 less than 40 percent of China's and Korea's manufactured goods were intended for final use—evidence of their role as a manufacturer of intermediary components for other markets.

These shifts in global production require a reconsideration of where value is created. When one country or metropolitan area manufactures a product from beginning to end, it's easy to assign value to a single location. GVCs are, in practice, much more complex.

In today's production lines, value creation occurs in multiple locations, through various firms, and typically spans manufacturing and service industries. Certain commodity chains involve global regions regularly exchanging goods back and forth, adding value in a game of economic hot-potato. One example is the North American auto cluster, where reports show parts crossing a national border eight times prior to final assembly.[66] Port towns and distribution centers similarly obscure the value-add picture: many regions developed specializations in light value-added activities like product warehousing and repackaging.[67] Markets across the world benefit from foreign direct investment, complicating the geography of production and it's financing.[68] Regions' tradable service sectors—like consultants, financiers, and logistics coordinators—also add value throughout the supply chain.

Manufacturing and Logistics Development of China's Pearl River Delta

China's Pearl River Delta (PRD) is one of the fastest-growing industrialized areas in the world. Fueled by rapid urbanization and a rise in manufacturing over the past thirty years, the network of nine cities located in China's southern Guangdong province operates as a key player in global trade and logistics. Since the introduction of several economic reforms in the 1970s, the PRD emerged as an industrial juggernaut, producing a wide variety of goods, attracting high levels of foreign investment, and transforming the very nature of global value chains.

Originally a center of agriculture, the PRD experienced widespread industrial growth after being classified as a special economic zone as part of a series of market-oriented reforms under then leader Deng Xiaoping.[69] Through China's "open door" policy, the region exercised greater control over its economic development by promoting capital investment, boosting exports, and facilitating trade. At the same time, with an influx of cheap labor and the adoption of new technologies, major cities in the PRD, such as Guangzhou and Shenzhen, expanded the scope of their economic activities and specialized in a broad array of commodities for global consumption.[70]

Despite only covering 1 percent of China's land area and containing 4 percent of its population, the PRD now accounts for nearly 10 percent of the nation's total output and one-quarter of its exports, which rose from $2.2 billion in 1980 to $359 billion in 2009.[71] The region, in short, has become an economic cornerstone for China and a factory for the global marketplace. Electronics account for the majority of these exports, including over $50 billion in communications equipment and $25 billion in computer parts during 2010 alone.

In combination with this manufacturing prowess, the PRD is also a global logistics hub. The broader region boasts three of the world's seven busiest container ports—the Port of Hong Kong, the Port of Shenzhen, and Guangzhou Harbor—moving a total of 61.2 million TEUs (20-foot equivalent units, an approximation of a shipping container) in 2011 alone.[72] Driving this throughput is not just exports but also imports. Partially attributed to companies' ability to avoid custom duties if they import components that will eventually be shipped to another country, half of the country's exports are related to processing inputs from other markets, and 40 percent of their export value is actually foreign value-added.[73]

Foreign investment also helped propel much of the industrial growth in the PRD. Hong Kong and Macau, given their geographic proximity, play a prominent role guiding the modern flow of capital into the region.[74] From 1980 to 1993, they accounted for almost three-quarters of all foreign direct investment (FDI) in the PRD by themselves.[75] Since then, levels of foreign investment surged higher, allowing for tremendous gains in output and operational efficiency. In total, the PRD had $16.9 billion in FDI in 2009, which made up almost 19 percent of China's total FDI during the same year.

To ensure its long-term success, the PRD and national government continue to make strategic investments related to global value chains.[76] Investments in the innovative ecosystem, like Shenzhen's "University Town," aim to educate the next generation of economic leaders.[77] With a population near the size of Spain but only a fraction of the land area, major cities continue to make targeted infrastructure investments to reduce congestion and support agglomeration economies.[78] Nationally, the central government continues to make interregional transportation investments, helping to link inland workers and manufacturing sites with the more prosperous coast.[79] All these investments are critical, for as the region's labor costs rise and consumer preferences shift, maintaining the region's role as a global manufacturing and logistics hub will require a different approach.

As a consequence, GVCs change how national trade balances should be calculated. For example, a 2013 OECD/WTO value-added database shows that applying value-added methods decreases the U.S. trade deficit with China by 25 percent, but reassigns most of that deficit to developed markets like Germany and Japan.[80] A broader study of 42 countries found that foreign content typically represented 27 percent of each country's national export value. While markets varied in their share of foreign value-add, this is a sizable representation of foreign inputs helping to generate domestic trade value.[81] A "Made in …" sticker no longer tells the whole value-add story.

Not only is it increasingly difficult to assign value along the commodity production process, the growth in global value chains also complicates trade mapping.[82] When specific firms control multi-regional commodity production processes, it is not clear how much value-add occurs in each facility. When contractors, suppliers, and manufacturers all have multiple relationships with one another across multiple commodity categories—what database designers call "many-to-many" relationships—spatial mapping becomes incredibly complex. These present major hurdles to accurately capturing today's global networks.

GVCs, and related approaches like global commodity chains, also face challenges in addressing tradable services. Gereffi and other researchers proved how tradable services are increasingly part of commodity production processes. However, mapping service flows is incredibly difficult, especially beyond firms' headquarters and satellite locations.[83] While this research series focuses on goods trade, services trade is a critical component of what metropolitan areas sell beyond their borders. For example, while the United States ran a nearly $800 billion deficit in international goods trade in 2012, it posted a surplus of nearly $200 billion in services trade.[84] Acquiring a clearer picture of metropolitan area services trade is a future frontier of trade mapping.

Implications for Metropolitan Economies and Freight Infrastructure

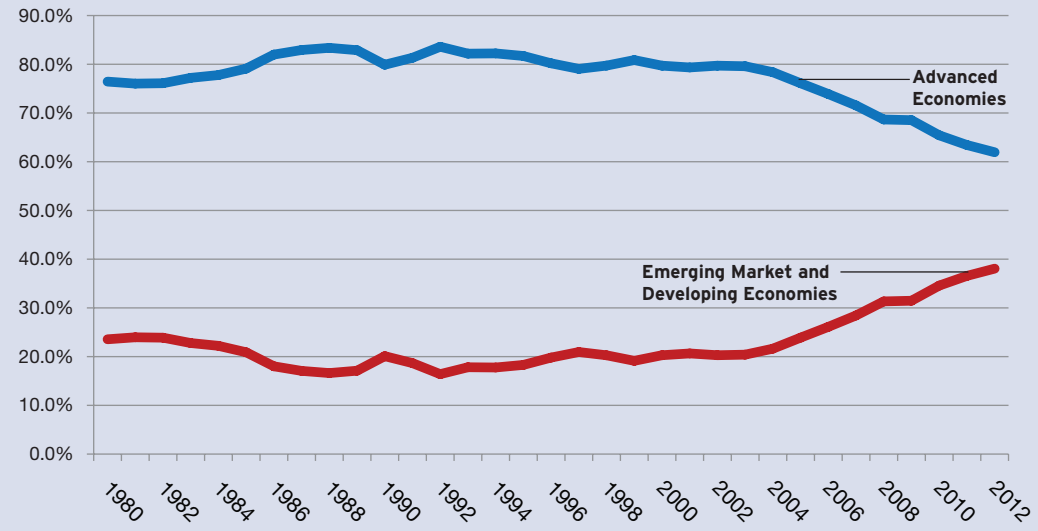
Every metropolitan area must recognize it is now part of the global economy.[85] For some markets, global connectivity is obvious: airplanes from Seattle, agriculture from Fresno, and computing equipment from Austin. These well-known export products create a clear connection to the global marketplace through their customer base. But it is often what metropolitan areas purchase—their inflows—that are their clearest global connection, especially from a consumers' perspective. Imported oil at the pump, out-of-season produce flown in from another hemisphere, and foreign electronics all represent a local connection to the global marketplace.

Being part of the global economy forces metropolitan areas to grapple with shifts in global market power. Unlike past decades and centuries, emerging countries constitute higher shares of global GDP. Since the mid-1990s, emerging and developing economies' share of world GDP is on an upward trajectory, more than doubling in less than two decades (Figure 1).[86]

This economic power shift has two competing implications. Of course, emerging markets have the ability to introduce products at lower costs, specifically due to lower labor expenses. The increased competition puts pressure on developed metropolitan areas to continue innovating or risk losing global market share. But they also serve as a market opportunity. As GDP growth rates slow within developed regions, developed economies can expand their economic potential by tapping growing demand in emerging countries. This is one of the fundamental imperatives behind export initiatives taking place in metropolitan areas across the United States.[87] However, emerging markets' growing output also places new competitive pressures on their developed peers. It increases the demand—and thereby prices—for natural resources like oil and rare earth metals.[88]

The presence of global value chains alters the logistical advantages for metropolitan economies. Efficient access to intercontinental shipping, especially in locations with low labor costs, can attract manufacturing investments from around the world—often at the expense of former manufacturing locations with higher labor costs. This is the story of China's Pearl River Delta, but also applies to burgeoning facilities elsewhere along Asia's Pacific coast.[89] The increased demand for seamless goods exchange and the increased competition for high-volume container routes spur port-related markets to develop new or improved facilities to grab business from rival markets.[90] For example, seven major European ports are consistently fighting for landlocked Austria's 8 million tons of annual shipping business.[91] Maintaining market share in international manufacturing centers like Detroit and Munich now requires efficient border transfer points to facilitate back-and-forth exchanges of intermediate

Figure 1. Country Groups' Share of World GDP, 1980-2012



Source: International Monetary Fund

commodities. In general, logistical positioning—especially access to major trade nodes—is a concern for any region.[92]

Global value chains also redefined how regions manage goods distribution.[93] In an effort to reduce costs, firms prefer leaner inventories and more frequent supply exchanges. These demands require extra port capacity and smooth intermodal exchange points. They also require modern distribution centers to manage the logistical symphony of products moving in and out of a broader region and its metropolitan areas. Such centers act as the communication and physical interface between domestic and global manufacturing outputs, regional product demands, and freight shipping patterns. They also tend to include warehouses, making them sites of value-added economic activity like repackaging.[94] Every metropolitan area looking to maximize growth in the global economy requires either local or regional access to a well-networked distribution center. They also must consider the repercussions of poor access, specifically in retaining or attracting productive firms.

Finally, global value chains put an even higher priority on transportation resiliency, which now stands equally alongside speed when firms consider logistical routing.[95] Coordinating value chains across multiple countries and continents, whether from a port, distribution center, or corporate management center, requires reliable goods movement between markets. This was never more evident than during the 2011 Japanese earthquake and tsunami, which crippled global supply chains, inflated certain commodity prices, and cut Japanese firms' profits.[96] Enhanced resiliency can be achieved through targeted capital investment in freight and logistics infrastructure as well as creating redundancies by geographically diversifying commodity chains, ensuring a delay in one region does not affect an entire global operation, or simply shortening supply chain distances.[97] Either way, resiliency is now a primary concern.

Freight Transportation Resiliency and the 2011 Japanese Tsunami

The fragility of global value chains becomes starkly apparent when infrastructure maintenance is lacking and expansion is needed. Natural disasters such as the Tohoku earthquake and tsunami off Japan's coast in 2011 also highlight the vulnerability—and importance—of these transportation assets for goods movement.

Triggered by a magnitude 9.0 earthquake—among the most severe in Japan's history—the tsunami crippled the daily rhythm of the world's third largest economy, closing ports, flooding roads, and washing away rail lines along the country's Pacific coast.[98] The extent of structural damage alone, estimated at nearly $300 billion by the Japanese government, displaced almost 340,000 people and halted industrial production for months in several locations, leading to additional disruptions in food supplies, goods manufacturing, and energy distribution. Many analysts believe the tsunami was a primary factor behind the 3.7 percent contraction of the nation's real gross domestic product during the first quarter of 2011, predicting that the full economic impact will likely last for years.[99]

Facing labor shortages and delays in shipping parts, Japan's automakers were among the hardest-hit manufacturers. Toyota and Honda, for instance, had to suspend operations after the tsunami, seeing their domestic production fall by almost 60 percent in March 2011 compared to a year earlier. These supply-chain disruptions, moreover, limited the companies' sales of new models in local and foreign markets. It also pushed these firms to consider shifting more long-term production closer to major consumer markets like the United States.[101]

The economic effects proved far-reaching. Accounting for 8.7 percent ($5.5 trillion) of global GDP at the time of the tsunami, Japan's supply chain disruptions reverberated throughout China, the United States, and Europe. In total, the tsunami was estimated to slow down global economic growth by about 0.2 percent.[102] While the effects were relatively modest as a share of overall trade, several worldwide electronics manufacturers and automakers faced costly delays, just as they did in Japan. Toyota assembly plants in the United States, for instance, lacked over 150 parts for several weeks, forcing them to operate at 30 percent capacity. Production at several Honda plants in the United States, Canada, the U.K., and India also fell by 50 percent during this same period.[103]

Although Japan constructed dikes, dams, and floodgates to withstand damage from serious coastal storms, the tsunami overwhelmed many of these structures and required significant infrastructure investment as the nation gradually recovered over the past two years.[104] In addition to damage sustained near the Fukushima Daiichi nuclear plant, more than 60 miles of the national highway, 200 miles of rail lines, and 14 international seaports were damaged and needed repairs.[105] The Japanese tsunami was one of the most devastating in recent history and highlights the need to protect vital infrastructure networks. Superstorm Sandy in 2012 similarly accelerated the development of resiliency strategies for goods movement in metropolitan New York.[106]

IV. Reconsidering Freight and Economic Policy

Metropolitan areas and their cities concentrate the assets required to succeed in a globally competitive trade environment. They house the human capital, innovation-producing firms, diverse industrial profiles, and major freight infrastructure capable of generating competitive advantages.[107] But those assets do not generate economic growth on their own. They need goods trade networks to maximize their economic potential.

Moving forward, metropolitan leaders need a firm understanding of these goods trade networks. Unfortunately, policies are not fully prepared to help reach that goal nor do we have the analytics to inform new practice.

Recognizing Domestic and Global Metropolitan Networks

Reliance on goods trade means metropolitan economies must understand the geography and components of their trade networks: which metropolitan areas supply their input and consumable goods, which metropolitan areas are their chief markets for their production specialties' outputs, and which markets are not yet a part of their networks but could be. This is the root importance of mapping goods trade networks.

Mapping goods trade networks is more than drawing connecting lines on a real or imagined chart. It also includes tracking particular trade components. Differences in value and weight, and how those relate to regional production specialties, can help illuminate this point. For example, many large metropolitan economies concentrate on high-value, low-weight products. One example is Minneapolis, where the metropolitan area specializes in manufacturing precision instruments like medical devices.[108] These products require particular freight needs, including access to airports and well-connected roadway networks.

Contrast these products with the opposite: high-weight, low-value commodities. Many of these products are land-intensive, such as agriculture, or can be environmentally damaging, such as energy extraction. These products require different freight infrastructure. Consider cereal grain exports from Iowa. To reach foreign consumers, those commodities are typically transported by freight rail or large trucks and pass-through ports in New Orleans and Portland, taxing local freight infrastructure assets in the process. Port facilities certainly understand the origins and destinations of their business, but other local actors may not have a clear understanding of these local transportation impacts.

Mapping goods trade is especially helpful in recognizing likely infrastructure needs. Based on a full suite of trade components—commodity type, value, weight, geographic pairing, and modal needs—public and private leaders can fashion short- and long-term freight strategies in response to physical and prospective goods movement. Large production firms can maximize distribution center and warehouse investments. Shipping and other logistics firms can procure ample space at major port nodes. Public agencies can prioritize long lists of capital investments. In each case, infrastructure assets will better reflect the needs of the economies it serves.

Marrying Freight and Economic Policy

America's federalist system ensures each level of government has a distinct role when it comes to freight policy. The federal government's constitutional responsibility is to regulate interstate commerce, which effectively includes the trade between states' metropolitan areas.[109] In practice, this means the federal government provides infrastructure planning, network construction, and fair trade and safety regulation between states and their metropolitan areas. State, regional, and local governments steward the freight needs of their jurisdictions, which creates the need to plan, build, and maintain their infrastructure assets. Equally important, all government bodies must consider private sector interests—from shippers and logistics firms to major commodity producers and consumers—as the primary users of the freight network. Figure 2 outlines these roles and responsibilities.

Yet within this system of shared and divided authority, federalist policy needs stronger links between freight and economy.[110]

U.S. Department of Transportation, the Army Corps of Engineers, and other federal agencies with any degree of freight oversight tend to assess and regulate freight within single transportation modes. This is a glaring omission of the interactivity between modes, multiplied by overlooking the economic

Figure 2. Current Roles of Public Agencies in the U.S. Freight System

* = Role | X = Role at Some Organizations

Government Level	Agency	Infrastructure, Development, Operation or Maintenance					Regulatory and Oversight					System Planning					Funding				
		R	T	A	O	W	R	T	A	O	W	R	T	A	O	W	R	T	A	O	W
Federal	U.S. Treasury/ U.S. Customs						*	*	*	*	*										
	Federal Highway Administration	*	*					*					*				*	*			
	Federal Aviation Administration			*					*					*					*		
	Maritime Administration											*	*		*						
	Federal Railroad Administration	*					*					*					*				
	Motor Carrier Safety Administration							*													
	Economic Development Administration		*			*												*			*
	Transportation Security Administration						*	*	*	*											
	Army Corps of Engineers				*					*					*					*	
	Surface Transportation Board						*														
State	State Departments of Transportation	*	*	X	X		*	*	X	X		*	*	X	X		*	*	X	X	
	State Economic Development Agencies																				*
Regional	Port and Airport Authorities	*	*	*	*	X	*	*	*	*	X	*	*	*	*	*	*	*	*	*	*
	Metropolitan Planning Organizations											*	*	*	*	*	*	*			
Local	Local and Municipal Governments	X	*	X	X		*	*	X	X	*	X	X	X	X	X		*	X	X	*

Key: **R** - Railroads **T** - Trucking **A** - Air Cargo **O** - Ocean / Waterborne Cargo **W** - Warehousing

Source: Robins and Strauss-Wieder, 2006.

forces driving freight activity. On the economic side, freight is primarily a regulatory concern for agencies like Treasury and Customs. The 2012 launch of a Department of Commerce advisory committee on supply chain competitiveness, which specifically considers policy improvements based on the intersection of goods movement and economic demands, does offer promise.[111]

Also promising is the development of a national freight strategy. Today the United States is one of the only industrialized countries that takes a compartmentalized rather than holistic approach to goods movement. However, while requiring a national freight strategy through the current surface transportation legislation (MAP-21) is a positive step, a truly national vision must integrate the modes (air, rail, sea, road, pipeline), add economic connectivity, and upgrade trade network analytics. That kind of foundation will also help federal programs prioritize projects of national significance, a fundamental investment responsibility for national government. Germany and the U.K. have developed helpful models that provide clear guidance on the development of integrated freight networks, as does the European Commission's *Freight Logistics Action Plan* to improve the efficiency of freight transport across the entire continent.[112]

Our federalist system also must do more to expand collaboration between government and the private sector. The country's freight transportation industry is highly decentralized, with private operators owning almost all of the trucks and rails, and the public sector owning the roads, airports, and waterway rights. And unlike our international peers, such as Germany, Canada, and Australia, the United States does not have a unified strategy that aligns disparate owners and interests around national economic objectives. The United States should consider more models like the recently-announced Commerce Department's *Investing in Manufacturing Communities Partnership*.[113] The program uses limited federal funding ($200,000 per community) to spur regional economic strategies that synthesize human capital, infrastructure, and manufacturing efforts. It is a remarkable step beyond incentive-based economic development strategies.

Developing a National Freight Strategy: Lessons from Canada and Germany

A national freight strategy helps link goods movement to broader economic policies, allowing for a more comprehensive approach to transportation and infrastructure investment. Without such a strategy metropolitan areas and other stakeholders may find it difficult to understand their place in the larger freight network.[114] However, many countries, including Canada and Germany, have established national plans and illustrate the importance of integrating freight across multiple modes and geographies.

In its national plan, Canada focused on identifying strategic gateways and trade corridors through an "integrated, system-based perspective."[115] Rather than isolating different modes, Canada's leaders developed plans in terms of the country's increasingly multi-modal needs. At the same time, they aligned their transportation network with other national priorities by viewing it in light of five key "policy lenses," which include: international commerce, current trade volumes, future goods movement, interconnected governance issues, and public-private partnerships.

Combined, these strategies strengthened Canada's competitiveness in global value chains. Launched in 2006 by Prime Minister Stephen Harper, the Asia-Pacific Gateway and Corridor Initiative (APGCI), for instance, reinforced connections between Canada and its Asian trading partners. Considered a vital element of the nation's economic plan—*Advantage Canada*—the APGCI funneled an additional $1 billion into strategic ports, rail lines, and highways throughout Western Canada.[116] In addition, by working with a range of partners from Canadian Pacific Railway to the Vancouver Port Authority, policymakers collaborated extensively while making these investments to promote greater cooperation and efficiency regarding freight.[117] Offering lower costs and more reliable intermodal services, Canadian ports like Prince Rupert began to aggressively attract increased traffic traveling between inland United States locations and world regions.[118]

Germany, likewise, adopted similar strategies to optimize goods movement and drive economic growth.[119] Seeing freight as a "linchpin of the economy," Germany's leaders aimed to build off the country's central location and enhance its technological capacity, while understanding the social and environmental implications of increased traffic in its transport system. Alongside several private-sector partners, the public sector created a freight policy framework that calls for increased funding in infrastructure projects, upgrades in transport arteries and hubs, a greater reliance on railways and inland waterways, and numerous other actions to further elevate Germany's position in global value chains.[120]

By setting specific targets for these measures and dividing responsibility among several different bodies, Germany's plan laid the foundation for strategic action on the ground. For example, minimizing congestion on roadways stands as an overarching priority for the Federal Ministry of Transport, Building, and Urban Development, while providing better traffic information for heavy goods vehicles falls primarily on the shoulders of private-sector companies, which will oversee organizational improvements. The creation of additional parking areas at service stations, the deployment of more traffic management systems, and the adoption of new signaling technologies for trains represent some of the initial projects undertaken. Altering toll rates on roads, mitigating noise on railways, and developing individual port strategies are among other measures adopted under the German plan, all of which will serve as a basis for future budgetary action.

Federal Freight Policy: MAP-21 and Beyond

While several countries use national freight plans to promote efficient goods movement, the United States has yet to finalize a national strategy. Although the Moving Ahead for Progress in the 21st Century (MAP-21) surface transportation law marks an important first step in this process—requiring the United States to develop a basic national freight plan by 2015—policymakers will need to consider further measures before the next reauthorization. Beyond MAP-21, a comprehensive freight plan should view different modes simultaneously and assess the nation's transportation needs directly in light of long-term economic priorities.

As it stands now, the freight plan specified under MAP-21 does not fully capture a multi-modal network. Rather, the legislation establishes several loose objectives for future action, focusing on broad policy goals. Assessing current and future freight volumes, identifying bottlenecks, and noting best practices are among its various provisions, which lack any clear benchmarks for implementation beyond five-year updates to the initial plan and the creation of new performance targets. The designation of a "national freight network" helps identify infrastructure critical to moving high volumes of goods, but this network is largely defined in terms of truck movement, limited to 27,000 centerline miles of existing roads and the construction of 3,000 additional miles of highway.[121] While trucks transport most domestic goods, waterborne vessels account for more than three-quarters of the weight and nearly half the value of American international goods trade.[122]

Including a national freight strategy in surface transportation legislation like MAP-21—rather than standalone legislation that would integrate other freight-related legislation like the Water Resources Development Act—makes it difficult to gauge how highways, railways, waterways, ports, and airports all function together to boost the nation's economic competitiveness. For example, MAP-21 calls for the identification of major trade gateways and freight corridors in the national freight network, but provides little detail on how to strengthen these assets, which often depend on a wide variety of modal connections. Almost exclusively, it concentrates on the operational performance of these modes in isolation, citing the need for additional investments and planning tools to improve their overall efficiency. Meanwhile, the prioritization of specific ports or rail lines, including the development of new intermodal facilities and transfer points, is unclear. The law also encourages states to develop freight plans, but they are not required.[123]

MAP-21 does make freight projects eligible for funding through the Projects of National and Regional Significance (PNRS) program, the Surface Transportation Program, Transportation Investment Generating Economic Recovery (TIGER) grants, and Transportation Infrastructure Finance and Innovation Act (TIFIA) programs.[124] TIGER grants, in particular, have a strong record of funding freight projects through their competitive process.[125] And MAP-21 also increases the federal funding share to 95 percent for freight projects on the Interstate Highway System and 90 percent for other projects—assuming states adopt freight plans and include the specified projects—but they are viewed in relative isolation.[126]

To fully capture freight's economic potential, then, the United States should coordinate activities among different federal agencies. The Department of Transportation, Department of Commerce, and the Office of the U.S. Trade Representative (USTR), among other bodies, need to work closely and have clearly-defined roles managing and regulating goods movement across the nation. As the Government Accountability Office (GAO) recently found, freight is too often fragmented among these various agencies, complicating long-term planning efforts and severing freight's economic ties.[127]

Ideally, the newly-formed Freight Policy Council will align these goals and prioritize projects of national importance, while policymakers continue to refine the objectives laid out in MAP-21.

Upgrading Analytics to Capture Metropolitan Trade Networks

Domestic and global trade networks are the connective tissue behind our metropolitan economies. Yet, while research and statistics show clear evidence of metropolitan areas' ability to generate and maximize trade, there is little understanding of exactly where trade occurs. Simply put, current analytics fail to capture metropolitan trade networks. In the process of building a more collaborative and comprehensive trade agenda, advanced databases and analytics have an especially important role to play.

One place to start is imports. Since 1960, the U.S. trade balance consistently runs a deficit, reflecting a macroeconomic reliance on imported goods from foreign markets.[128] However, those imports do not exist in a vacuum—they likely land in the metropolitan areas generating the vast majority of American economic output. The problem is no data source currently tracks imports to their metropolitan destination; the closest data source is U.S. Customs data reporting import trade at the Customs district (a non-metropolitan geography in the first place). Since the U.S. imports significantly more goods than it exports, it is critical for metropolitan economies to understand which countries supply their locally-consumed commodities and what alternative geographic sources exist.

Export reporting is significantly better at the metropolitan scale, but is not perfect. Partially inspired by quantitative reporting conducted by the Brookings Institution in 2010, the U.S. International Trade Administration began publicly reporting metropolitan export statistics.[129] However, this dataset is incomplete for freight purposes. First, it does not include transportation elements such as transportation mode or international port. Second, it does not assign international trading partners beyond the 50 largest metropolitan areas. Third, it assigns exports based on the point of last movement, which often varies from the point of production.

Deficiencies in the country's only public origin-destination database, Census' Commodity Flow Survey (CFS), limit the ability to assess domestic metropolitan goods trade, too. First, CFS administration does not keep up with the speed of domestic and global economic trends as Census only conducts the CFS every five years. By the time the calculations are complete and reported to the public, macro and metropolitan economies are often in the midst of an entirely new economic cycle. For example, the most recent CFS from 2007 represents a pre-Great Recession economy. Second, the survey does not offer data for all metropolitan areas, while others are incomplete due to state borders.[130] The CFS does provide important information, but it could be even more valuable with targeted improvements.

There are two primary alternatives to the CFS, but neither is perfect. The first is another public dataset, the Freight Analysis Framework (FAF) from U.S. Department of Transportation. That dataset supplements CFS data with transportation modes and forecasts. However, by using CFS as a baseline, it suffers from the same timeliness and metropolitan scale issues.[131] FAF also undergoes significant methodological updates between 5-year versions, disabling the ability to easily create longitudinal analyses in exchange for methodological improvements. FAF consumers would greatly benefit if the database series could apply methodological improvements to past databases and enable longitudinal comparisons. Private data alternatives exist but are expensive and proprietary.

These data deficiencies come at a real cost. First, it limits metro leaders' ability to capture their goods trade balances and how those balances relate to local economic profiles. Trade balances are a valuable tool to highlight what commodities a metropolitan area consumes locally, and vice-versa for which commodities serve as outflows. Missing trade balance data creates a missing translation tool between local industry data and infrastructure needs.

Second, problematic data means metropolitan leadership cannot understand their place in domestic and global trade networks. The growing complexity of manufacturing and service networks make it more important than ever to track where a metropolitan area falls in a commodity chain. Which trading partners supply the natural resources? Where do the intermediate inputs come from? What markets demand the final consumable products? The lack of location-specific trade relationships makes it difficult to contact common trade peers, establish mutually beneficial policies, or determine future areas for manufacturing and broader economic development.

V. Conclusion

The exchange of goods is a fundamental element of how metropolitan economies grow and prosper. It enables places to develop production capabilities and leverage the concentrations of economic specialties found in metropolitan areas. Goods trade matches economies based on complementarity, actualizing the principles of supply and demand and helping to guide local economic development policy.

To make this growth possible, metropolitan areas have used freight transportation networks to forge connections between places. From the Mediterranean's earliest trading ships, to England's natural waterways, to the America's vast highway network, freight technology and capacity has always set the pace for how quickly and easily trade could occur.

Today's freight innovations have helped drive trade to previously unseen heights, unleashing a broad wave of global economic growth and a dramatic remapping of the world's production networks. Value chains now stretch across the world, pushing manufacturing and service industries to the sites of the greatest transportation reliability and production affordability, in the process redefining how locations add value to specific products. As a consequence, the world's metropolitan economies now face a more competitive environment for people, for investment capital, and for goods.

Increasingly, metropolitan economies require a clear understanding with whom they trade and how transportation assists in making those connections.

Current U.S. policies fail to reflect this new reality. The federal government continues to separate freight and economic planning, and has only begun shaping a limited national freight strategy. Local and regional governments continue to live in the dark when it comes to identifying their domestic and global trade partners. And at all levels of government, analytics fail to offer policymakers the information necessary to make informed decisions.

This series aims to address those gaps. It will offer policymakers at all levels of government and their colleagues in the private sector a toolkit to map and analyze goods trade in the 21st Century. Only when armed with that knowledge, can leaders make the difficult decisions it will take to prosper in a hyperconnected, hypercompetitive global economy.

Endnotes

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2. Brookings analysis of Moody's Analytics data.
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16. Robert Puentes and Adie Tomer, "The Road … Less Travelled: An Analysis of Vehicle Miles Traveled Trends in the U.S." (Washington: Brookings Institution, 2008).
17. Different economic theorists use different terms for "inputs" and "factors of production" as well as the primary elements; this brief uses a definition closely aligned with classical economics.
18. For hundreds of years, economists have used trade's fundamental components of comparison and exchange to explain how metropolitan areas develop. Goods trade powers Adam Smith's concept of product specialization: the idea that individuals or companies can expand their production by specializing in a particular product, and then sell the surplus amounts to purchase other products. Goods trade underpins David Ricardo's concept of comparative advantage: the idea that markets will produce those products that deliver the greatest return on investment when trading with their peers. Goods trade empowers Alfred Marshall's original concept of agglomeration economies: the idea that clustered firms and workers can generate more products than firms and workers in isolation, which will provide even greater surpluses to exchange with other markets. For more information on how these economic concepts relate to trade and metropolitan economies, see: Alan Berube and Joseph Parilla, "MetroTrade: Cities Return to their Roots in the Global Economy" (Washington: Brookings Institution, 2012).
19. Trade complementarity is not the same as complementary goods, which are goods that tend to be consumed together or used in consistent proportions. Classic examples of complementary goods are printers and ink cartridges, cars and gasoline, and left-footed shoes and right-footed shoes.
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33. Source (entire paragraph): Greater Memphis Chamber, "Memphis Regional Freight Infrastructure Plan," online at **http://www.memphischamber.com/Articles/DoBusiness/Aerotropolis/Memphis-Regional-Freight-Infrastructure-Plan-March.aspx** (2010) [accessed June 2013].

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- Provide metropolitan area leaders with proven, actionable ideas for how to expand the global reach of their economies, building on best practices and policy innovations from across the nation and around the world.
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