GLOBAL SUPPLY CHAINS

The Complicated Road Back to “Normal”

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GLOBAL SUPPLY CHAINS
The Complicated Road Back to “Normal”

It feels that the pandemic has made changes to just about everything in daily life. Not only have our routines changed, but we have also been put on a steep learning curve of new concepts. First, there was a need to get up to speed on disease prevention (e.g., transmission rates, viral loads, and how mRNA vaccines worked) as well as hospital capacity. As we shifted from commuting to offices and schools to working and learning remotely, we needed to get up to speed on home technology and remote applications. Lockdowns and quarantine orders meant the hunt for basic goods such as toilet paper and cleaning supplies became challenging, and suddenly economics and supply chain disruptions became part of our daily news feed.

We have also learned the global supply chains we thought were optimized and secure were actually riskier than we originally thought. The shift over the past 40+ years to just-in-time inventory and global manufacturing generated benefits for consumers, corporates, and governments. However, the pandemic added a new set of unforeseen challenges. On the supply side, border closings and lockdowns kept production sites shuttered, while on the demand side consumers who could not spend on things like vacations and dining out, increased their spending on durable goods. As businesses tried to fill this demand, they found they weren’t able to secure intermediate goods or ingredients needed for production, and the typically smooth cadence of trade flows became uneven, leading to supply chain disruptions.

Citi’s Global Chief Economist Nathan Sheets identifies six macroeconomic factors that have come into play and disrupted global supply chains: (1) supply-chain management practices, (2) a shift in consumption toward goods, (3) massive monetary and fiscal stimulus by the public sector spurring aggregate demand, (4) the emergence of the Delta variant, (5) a shortage of available workers, and (6) commodity shocks that amplified other supply-side pressures.

Because more than one cause or event got us to our current situation, one single solution will not relieve the stress. Ultimately, the overall solution to resolving supply chain disruptions is tied to improvement in the pandemic. Addressing the other macroeconomic issues will take time, but we are already seeing key indicators improve — e.g., congestion issues at U.S. ports, and prices in energy markets and commodities. Without any other major setbacks, we believe supply chain issues should feel better in the first half of 2022 but probably won’t get back to normal until well into 2022 and beyond.

Over the next year or so, corporates will also likely take some time to review their supply chains and make changes based on lessons from the pandemic. These may include embracing digitization; placing a greater emphasis on long-term alliances and partnerships with suppliers; holding larger inventory buffers, especially for critical components; simplifying and bringing supply chains closer to home; and decreasing the amount of global integration to protect themselves from the next shock.

To get an “on the ground” view, we talk to Shahmir Khaliq, the Global Head of Citi’s Treasury and Trade Solutions division, about strategies to mitigate today’s supply chain challenges; and the importance of both working capital management and environmental, social, and governance (ESG) on global supply chains.
The Need to Make Supply Chains Resilient

HOW DID WE GET HERE?

Supply chain disruptions have quickly cascaded around the globe. The primary driver is the demand for goods far exceeding supply as consumer spending shifted away from services during the pandemic. We note six key macroeconomic drivers:

Supply Chain Management Practices: Intra-industry trade has increased over decades, with a shift to “just-in-time” inventory management.
Source: Citi Research, UN World Development Report

Shift in Consumption Towards Goods: Households shifted spending away from services, leading to pressure on global production chains.
Source: Citi Research, BEA, Haver

Massive Fiscal and Monetary Assistance Spurred Aggregate Demand: Advanced economies saw debt-to-GDP ratios increase by 15pp of GDP or greater.
Source: Citi Research, IMF, Haver

4. Manufacturing PMI (October 2021)
The Delta Variant: Production shut downs in hard-hit Asia led to declines in the global purchasing managers' index for manufacturing.
Source: Citi Research, IHS Markit, Haver

A Shortage of Workers: A ramp up in production capacity is hampered by worker shortages in key industries.
Source: Citi Research, BLS

Commodity Shocks Amplifying Pressure: As suppliers struggled to keep up with demand, prices of key commodities were also rising.
Source: Citi Research, Bloomberg

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Current supply chain tensions will not be solved simply by waiting for supply to “catch up.” To relieve the stress in global trade, we ultimately need to see an improvement in the pandemic. Some specific supply chain issues are beginning to unwind but there are still a number of lingering unknowns.

**FUTURE SUPPLY CHAIN MANAGEMENT STRATEGIES**

Given the vulnerabilities in supply chains exposed by the pandemic, many firms will feel obliged to review the pandemic’s lessons and make adjustments in their operations. Potential areas of focus include:

- **Embracing digitization** and electronic tracking of inventory and logistics
- **Emphasizing partnerships** with suppliers and long-term alliances
- **Shifting inventory management strategies** to hold larger buffers, especially for critical components
- **Simplifying supply chains** and bringing them close to home
- **Declining global integration** in order to protect national economies during times of crisis

**Issues Already Starting to Improve**

- Issues at U.S. ports, including trucking, empty containers, and congestion
- Prices in energy markets
- Memory chip shortage
- Congestion at West Coast ports

**Vulnerabilities Still Remaining**

- Delayed rebalancing to services
- Inflation
- Impact of increased household savings
- Persistent labor shortages

**RELIEVING THE STRESS**

Current supply chain tensions will not be solved simply by waiting for supply to “catch up.” To relieve the stress in global trade, we ultimately need to see an improvement in the pandemic. Some specific supply chain issues are beginning to unwind but there are still a number of lingering unknowns.
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Introduction

As the global economy recovers from the pandemic, global supply chain disruptions have emerged as a significant, and unforeseen, challenge. These disruptions have cascaded with surprising speed and power to countries around the world. The global auto sector, in particular, has been devastated. With producers unable to get the semiconductors needed for new vehicles, dealer inventories have fallen to historically low levels. This, in turn, has sent the price of used cars — and rental cars — spiraling upward. But autos have not been alone. The effects of these disruptions have also manifest themselves in rising shipping and logistics costs, clogged ports, and shortages in goods ranging from electronics and appliances, to furniture and toys.

Since the middle of 2021, these tensions have burst into the public consciousness. For consumers, the evidence of the challenges is almost everywhere — goods out of stock, furniture and appliances that require months for delivery, sky-high auto prices, and mounting signs of overall inflation, which are starting to pinch into workers’ real wages.

As one perspective on these developments, Figure 1 reports an index of global news articles and company documents that reference supply chains. While these issues have been front and center throughout the year, the focus surged upward through September and October and also took a more concerned and negative tone. Although this index has moderated a bit recently, it remains elevated. The same pattern holds if the search is restricted to just the U.S. Strikingly, such worries previously peaked during the summer of 2021, but then stepped up again in towards the end of the year. Rising demand in anticipation of the holiday season is likely one factor intensifying pressures on supply chains of late.

Figure 1. Trend Scores on Supply Chains

Source: Citi Research, AlphaSense
Supply Chains in the News

Figure 2 provides a further regional breakdown on mentions of supply chain-related terms in global news and media outlets, measuring both news volume and sentiment. The volume of news related to supply chains has been increasing in Asia since the early stages of the pandemic, while North America and Western Europe started to show a similar trend from late 2020 onwards. The sentiment embedded in the news took a dive at the beginning of the pandemic across all regions. Despite a short recovery during the middle of 2020, sentiment has declined substantially in the second half of 2021, with the exception of North America in September and October 2021.

Figure 2. Supply Chain Related News and Sentiment by Region

Digging a bit deeper, Figure 3 shows the main topics underpinning the news around supply chains over the past two years. By counting the number of mentions of each supply chain-related concept in the news that we captured, we found the most discussed topic in supply chain news has been shortages (of both materials and labor). Moving further to the right of the treemap, keywords such as food storage, shipping, and manufacturing also appear. This raises the question of to what extent good supply chain management — through optimization, inventory control, and the use of digital software — relieves the impact of supply chain disruption when it strikes at a global scale.
As we will discuss, the evolution of these developments — and their eventual unwinding — will have first-order implications for the performance of the global economy through the year ahead. Shortages and shipping delays threaten to continue to drive up prices. In parallel, production challenges and the reduced availability of goods threatens to hold back real spending — people cannot buy goods that are not produced or cannot be shipped.

One factor complicating our understanding of this episode is its novel nature. As a sizable global “supply shock,” it bears some similarities to the oil shocks of the 1970s. But the economy today is much different than it was then. For example, as the oil shock hit, the global economy was rolling forward with structurally strong aggregate demand. In contrast, the demand for goods is currently elevated, but this feels more episodic in nature (i.e., it flows from the specific circumstances that have prevailed during the pandemic). In the preceding decade, global demand showed sustained softness. Another difference relative to the 1970s is that global central banks are more credible and inflation expectations more firmly anchored. While the current episode is challenging some of these presumptions, our sense is that the 1970s provide only limited insights as to what we might expect.

But perhaps even more broadly, not only were these disruptions unforeseen, many observers were convinced that supply chains were optimized — robust, reliable, and cost-efficient. The prevailing view was that the global economy’s apparent flexibility, coupled with advancing information technology (IT) and tracking techniques, was allowing firms to both minimize inventory carrying costs and maintain fully reliable access to inputs.
Reminiscent of the global financial crisis, these disruptions are manifesting vulnerabilities in a part of the economy that was previously believed to be both strong and sophisticated. President Trump’s trade wars were a warning shot in this regard, but the pandemic has necessitated a full-blown reality check.

All of these observations have important consequences for the corporate sector. This is true because firms must navigate a more uncertain and disrupted macroeconomic environment, as well as the challenge of assessing shifting demand and pricing realities in the face of rising input costs. This is also true because, as a microeconomic matter, firms must source, produce, and ship despite these disruptions. A related issue, which is increasingly front and center, regards supply chain management in the years ahead. What steps can be taken to make supply chains more resilient while also preserving the cost efficiency that firms have come to rely on?

Supply Chain Complexity and Interdependency

Oftentimes the supply chain of large corporates are extremely complex due to the global nature of operations and the diversity of products produced. By taking a sample of 12 large industrials companies globally, we examine the interdependency of supply chains of these companies, tracing three layers upstream of their suppliers.

In Figure 4, the width of each pipe represents the total relationship amount between each supplier and customer sector pair. This helps identify the biggest sectors by dollar amount in the supply chain that are crucial to the final product/service the end-companies provide. The darker color intensity of the sector corresponds how “concentrated” that sector is — a high concentration means the majority of the transaction flow for a sector is attributed to a small number of companies. This is a useful proxy to identify sectors in the supply chain that are heavily reliant on a few companies, which makes them more susceptible to supply chain shocks.

The chart also demonstrates that inter-sector supply chain dependency in terms of the related dollar amount which propagates beyond the second and third supply chain layers. Any disruption to certain industries, therefore, could have a ripple effect that could be amplified through these overlapping layers.
This paper lays out a macroeconomic framework based on six macro factors that have propelled the disruptions.

We conclude that (1) supply chain pressures have stopped getting worse; (2) sustained easing will require containing the virus further; (3) resolution of different aspects of these pressures (not full resolution) will reach a critical mass in the spring of 2022; and (4) firms will likely adopt strategies that increase inventories and simplify supply chains.

In this paper, we lay out a macroeconomic framework that provides some structure for thinking about the underlying drivers of this episode. Specifically, we consider six macro factors that have been at work in propelling the disruptions. Together, these have supplied the initial conditions for, and subsequently, have driven or amplified the difficulties. We then attempt to extract some insights from the available macro data about where things currently stand. And we conclude with thoughts as to how these stresses may eventually resolve.

Our work supports several important conclusions. First, the balance of the available data suggests that supply chain pressures, although still intense, are now at a point where they have stopped getting worse — and they may even be showing some signs of easing. Nevertheless, these indications are still preliminary, and we are inclined to interpret them with caution. The data similarly appeared to be stabilizing, or even improving, midway into 2021 but then deteriorated sharply with the onset of the Delta variant.

Second, as a related matter, our assessment is that a sustained easing of these disruptions will require further progress toward containing the virus. The economic stresses that have flowed from multiple waves of lockdowns and re-openings have contributed critically to the tensions. The global inventory system was not designed to absorb the highly uneven stops and starts in demand and production that the pandemic has caused. For this reason, we see the ongoing global vaccination campaign as a critical contributor to an easing of supply chain pressures. That said, the emergence of the Omicron variant in late November 2021 highlights that these risks have not abated.
Third, we expect that different aspects of the stresses will resolve at differing rates. That said, our analysis suggests that a critical mass of supportive factors — i.e., an easing of seasonal demand, an improving energy-price picture, and progress toward unclogging the ports — will likely emerge through the spring of 2022. However, the situation is unlikely to be fully resolved until well into 2022 or, perhaps, even thereafter.

Finally, one deeper issue that firms will be wrestling with in the aftermath of the pandemic regards the appropriate strategies for supply chain and inventory management. The recent experience has highlighted marked vulnerabilities in the approaches that prevailed in the years before the pandemic — and firms are likely to take steps toward increasing the size of their inventories and simplifying the structure of their supply chains. The open question is how vigorous and widespread such efforts will ultimately be.
Some Underlying Macro Contributors to the Disruptions

As we tackle these issues, we realize that, ultimately, the contours of supply chain disruptions are microeconomic in nature. They flow from thousands of decisions made by firms about production, shipping, and inventory management. They also flow from complicated logistics realities at major ports and from the decisions of millions of individuals about whether to enter the labor force and, if so, what job to take — and from the decisions of consumers about when and what to buy.

In line with this, the macro data and, indeed, macroeconomic perspectives can only provide glimmers of insight into the stresses. Even so, economists often reference an axiom that limited information is better than no information. And, in the best tradition of the profession, we generously deploy that axiom here.

We begin with the important observation that the supply chain disruptions are not one phenomenon with one underlying cause, but many different phenomena with many causes. The drivers are ultimately linked to a confluence of interrelated factors. Similarly, the manifestations of these stresses are multifaceted, and they are playing through the economy and the business sector in a variety of ways.

But our diagnosis of the situation is the following: The pandemic brought a sustained substitution in consumer spending toward goods; coupled with the sizable macroeconomic stimulus that was put in place, this has meant that as the global economy started to recover, the demand for goods has far exceeded supply in many sectors. These days, ordering a product is as easy as “point and click.” But producing those products requires setting production plans, finding suppliers, locating workers, and much more — all of which require real time.

In sum, the recovery from the pandemic — and the actions taken to support the economy — have led to a situation where the demand for goods has run well ahead of their supply. The resulting supply-side disruptions are, at least in part, due to firms desperately trying to catch up.

A related point is that these shocks have had varied effects across regions. In the U.S., which seems to be the center of the storm, the demand for goods has been especially robust through the pandemic. The economy is feeling the pressures associated with the supply chain disruptions, while it is also buoyed by strong demand. Thus, the prices of goods are rising with particular vigor (driven by both the strength of demand and disruptions in supply), but spending and output have remained well supported.

Europe in contrast is mainly feeling a pinch in supply, while aggregate demand has been less exuberant than in the U.S. The result has been a marked increase in prices and a reduction in real wages, which has trimmed household purchasing power.

In emerging Asia, the disruptions have had some features of an external demand shock. Firms have not been able to produce and sell the same quantum of goods as before, and excess supplies have in some cases been sold in local markets. The result has been wider output gaps and downward pressures on core domestic prices. Many emerging markets outside of Asia, however, have struggled with the inflationary effects of the shock, and their central banks have been pushed into defensive rate hikes to protect their credibility.
With these high-level observations in hand, we now look at the remarkable array of factors that has been at work in setting the stage for and amplifying these disruptions. We consider six key macro drivers.

1. Supply Chain Management Practices

First on this list is the supply chain management strategies that prevailed pre-pandemic. In an effort to achieve cost efficiency, firms scoured the globe for the cheapest suppliers. The result was often far-flung and sometimes complicated supply chains that spanned national borders. Another goal was to keep inventories as lean as possible to minimize the cost of financing.

This move toward supply chain complexity evolved in the decades before the pandemic. It was motivated by the rise of Japanese manufacturers, most notably in the auto industry, whose exports were considerably more competitive than those of their competitors. One of the key elements of their competitive advantage was the practice of “just-in-time” inventory management, which was subsequently popularized and became widespread. As this approach became common practice, firms were able to reduce their inventory costs and improve their overall efficiency.1

In tandem, the commitment of policymakers to pursue a more globalized economy, and accompanying efforts to bring down tariffs and remove barriers to capital flows, also contributed by allowing “vertical specialization” — firms (and even countries) focused on particular links in the supply chain. This trend was reinforced by a reduction in underlying transportation costs, as well as advances in information and communication technology. Firms were increasingly free to seek out the world’s cheapest suppliers of their inputs. At the same time, this process tightened global interdependence, especially between the East Asian economies and the rest of the world.

In line with these observations, Figure 5 highlights that, since the 1960s, global trade of all types of goods has been increasingly influenced by intra-industry trade. These transactions, especially for intermediates, represent exchanges between firms at different points on the production chain, rather than exchanges between firms in fundamentally different industries. Our sense is that this process peaked in the years before the global financial crisis, but it broadly continued in the decade preceding the pandemic.

Figure 5. Share of Intra-Industry Trade by Types of Goods (2006)

Source: Citi Research, UN World Development Report

U.S. inventory-to-sales ratios fell sharply during the 1980s and 1990s and remained low before the pandemic.

Figure 6 focuses on inventories and tells a complementary story. U.S. inventory-to-sales ratios fell sharply during the 1980s and 1990s and generally were maintained at low levels in the years preceding the pandemic. While these data focus on the U.S., the general trend prevailed in many other countries as well.

Figure 6. U.S.: Private Inventories/Final Sales (3Q 2021)

Source: Citi Research, Haver
The evidence suggests that these trends were strongly endorsed and, indeed, reinforced by financial markets. As shown in Figure 7, markets tended to value capital-light business models more generously than capital-intensive business models.¹ This was true across countries, but it was also true within industries. As such, firms could reasonably hope that outsourcing capital-intensive portions of the production process would drive up their share price.

Figure 7. Markets Prefer Payouts to Capital Expenditures (2019-20)

Source: Citi Research

Notably, the conventional wisdom through this period was that the innovations in supply chain and inventory management were contributing to more efficient overall economic performance. For example, it was suggested that these approaches were dampening swings in inventories and, thus, helping to reduce the volatility in real GDP and stabilize the business cycle. These supply chain and inventory-management strategies performed well during normal times, as well as through several business-cycle shocks.

But with supply chain disruptions now cascading through the global economy, it is clear that these approaches were critically conditioned on the assumption that linkages with the rest of the world were reliable, predictable, and cost-effective. In retrospect, it seems clear that there was more vulnerability in the system than most observers appreciated. Notably, these vulnerabilities were highlighted by President Trump’s trade war with China, but they have been even more fully exposed by the pandemic.

2. A Shift in Consumption Toward Goods

A second important macro driver of the stresses has been a massive shift in consumption away from services toward manufactured goods. This rebalancing has flowed directly from the incentives that households and firms have faced through the pandemic.

¹ For more information, please refer to Citi Research, “Global Equity Strategist: Value Investors Are Long Capex,” July 19, 2019.
Given the nature of the pandemic, the consumption of most (non-essential) services became nearly impossible in the early months of the pandemic and more difficult than usual afterwards. In contrast, households and firms quickly realized that the production and consumption of goods is generally more compatible with health precautions than is the case for services, many of which require face-to-face contact.

Accordingly, cars and furniture were substituted for vacations and travel; computers were substituted for meals in restaurants; and sporting goods and gardening supplies were substituted for movie tickets. As demand in these sectors has grown, in some cases surging well above pre-pandemic levels, the result has been pressures on global production chains, shipping capacity, and commodities markets — all of which are necessary to manufacture and transport goods.

Figure 8 provides concrete data on this rebalancing away from services, as well as its global dimensions. Across a group of advanced countries, many saw a large contraction in the share of services early in the pandemic, with only an anemic bounce back subsequently. Nevertheless, among these countries, the U.S. clearly stands out — both for its large services share before the pandemic and for the sharp drop in services recorded in the spring of 2020.

Figure 9 highlights these observations drawing on detailed data for the U.S. consumer. Spending on durables soared through 2020 and has remained high in 2021. It has retreated a bit recently, but that mostly reflects a slowing in auto sales — due not to a slackening of underlying demand but, rather, to the inability of dealers to get the desired cars. Non-durables also have posted a large gain. In contrast, services spending has come back up, but remains below its pre-pandemic level.
Credit Card Data and Personal Consumer Expenditures

The use of card transaction data as an early barometer of spending in the U.S. is being explored including by the U.S. Bureau of Economic Analysis (BEA). We examine consumer spending behavior using Citi’s own proprietary credit cards data on a monthly frequency. It is clear from Figure 10 below that the trend of card spend data tracks the official personal consumption expenditure (PCE) data well, and recent data points suggest a rebound from earlier plateauing for all four sectors into November 2021.

Figure 10. Citi U.S. Retail Credit Card Spend

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3 All series indexed to 1 on September 30, 2019.
3. Massive Fiscal and Monetary Stimulus Has Spurred Aggregate Demand

A third contributing factor to the disruptions has been the massive fiscal and monetary stimulus provided by the public sector to fight the pandemic. This support has been essential in keeping firms afloat and preserving workers’ jobs and incomes during the pandemic. Households have been primed to spend; and given the features of the pandemic, much of this spending has landed on goods.

The dimensions of the fiscal stimulus are substantial (Figure 11). During 2020, many of the advanced economies saw increases in their debt-to-GDP ratios of 15 percentage points of GDP or greater, with debt levels approaching or exceeding 100% of GDP. The increase in indebtedness among the emerging market economies was typically a notch more restrained but nevertheless historically large.

**Figure 11. General Gross Government Debt-to-GDP, 2019 Level vs. 2019-21 Change**

Several governments, especially among the advanced economies, have since pursued fiscal expansions that are no longer focused on pandemic-related issues but, instead, seek to provide long-term investment in infrastructure, green technology, and education. In contrast, however, other governments have moved toward fiscal consolidation. Such efforts have stemmed from looming market pressures, for example, in Brazil and South Africa, or from the government’s preferences for policy restraint, notwithstanding ample fiscal space (emerging Asia). Even so, the overall global fiscal stance is expected to remain relatively loose on a cyclically-adjusted basis.

Coupled with fiscal stimulus has come comparably massive monetary stimulus from central banks. In advanced economies, and some emerging markets, policy rates were set at or near the effective lower bound (Figure 12 and Figure 13). In addition, many advanced economies, and some emerging markets, adopted sizable asset purchase programs during the depths of the pandemic to push down market interest rates, support spending, and stabilize markets.
Rising inflation has called into question the future of asset purchase programs in advanced economies.

Consumer savings significantly increased during the pandemic and remains above long-term averages.

The recent upsurge in inflation has prompted central banks in the advanced economies to increasingly wrestle with the future of their asset purchase programs, as well as with the appropriate gearing of their policies more generally. The U.S. Fed’s ongoing efforts to calibrate the timing and pace of tapering has been especially front and center. What is clear is, at least for now, these economies face a different distribution of risks than before the pandemic — and, as a result, central banks must be prepared to act more aggressively than has been appropriate in recent years. In the emerging markets, a sizable fraction of central banks have started to normalize policy rates but, even so, rates typically remain stimulative relative to recent historical experience.

Figure 14 and Figure 15 highlight an important related development. The pandemic has seen a significant increase in consumer saving. This has reflected the fiscal support that has been provided to households, a good chunk of which has been used to bolster liquidity buffers or pay down debt, as well as a pulling back from spending due to the rigors of the pandemic. With consumers locked down inside of their homes and worried about their health, the scope to spend was correspondingly constrained. Also, given disruptions in the labor market, incentives for precautionary saving likely increased for many households. While the saving rate is now normalizing, it remains above long-term averages.
With global consumers sitting on trillions of dollars of excess saving, the “dry powder” for future expenditures seems significant. The open issues are how much of this is eventually spent and at what pace? Also, as a corollary, to what extent does the resulting spending fall on goods versus services?

We have only limited historical experience to draw on to address these questions, but the answers will shape the path of global recovery over the next several years. In addition to the implications for demand, this cumulated saving is a likely contributor to the sluggish recovery of labor markets (discussed below), as it has given some workers resources to delay their return to employment.

**4. The Emergence of the Delta Variant**

The Delta variant appears to have played a central role in the recent intensification of supply chain pressures during August and September of 2021. The resurgence of the virus made an already challenging situation even worse. This occurred through two channels.

First, the Delta variant hit Asia particularly hard, and Asia is a critical global producer of intermediates and other goods currently in high demand. As countries in the region moved to fight the spread of the virus, the containment measures intensified disruptions in production. We have seen closures of Chinese ports and slowing factory production in countries such as Thailand, Vietnam, and Malaysia (which alone accounts for 13% of the chip supply required by auto producers). Thus, already snarled lines of supply became even more tangled.

Second, the natural course of recovery from the pandemic is likely to bring a rebalancing from goods back toward services. Some meaningful evidence of this was observed in the acceleration of global activity that occurred during the first half of 2021. But the rise of the Delta variant forestalled further progress in the rebalancing back toward services. As a result, household demand for goods has remained strong, even as the pandemic has disrupted the production of those goods.

The signature of these dynamics is evident in the recent behavior of global purchasing manager indices (PMIs) (Figure 16 and Figure 17). Around July 2021 these measures of global activity registered notable downturns. The services sector in the advanced economies appears to have been hit particularly hard, while the services PMI for the emerging markets has generally moved sideways. The manufacturing decline has been more measured, but this may be understating its intensity. Specifically, the extended delivery times and lean inventory levels associated with the supply chain stresses are incorporated as favorable indications in the calculation of this measure, since during normal times such conditions would signal favorable demand conditions. As one glimmer of good news, however, the services PMIs edged up in September and October of 2021.
Another important macro factor, which is also related to the pandemic, is an apparent shortage of workers at key points in the supply chain — for example, drivers to help move goods at the port and then on to their final destinations (Figure 15). This shortage seems particularly acute in the U.S., but other countries are also feeling labor market pressures. Notably, Malaysia reports that 600,000 foreign workers have left the country since the pandemic commenced. A similar story can be told about migrant workers in Thailand, Vietnam, and Singapore (Figure 16). Thus, ramping up production capacity to pre-pandemic levels could prove challenging for these countries, at least in the near term.
Job Opening Duration

Global job opening duration data by sector highlights the issue of labor shortage was at a peak in early to mid-2020 where the average opening duration was the longest compared to pre-pandemic levels, as shown in Figure 20. Key sectors such as energy and health care were among those that were first to see a supply shortage, followed by other sectors. Furthermore, the shortage of labor is a global phenomenon observed in the top five countries by job postings volume. In particular, the labor shortage issue had a prolonged impact in China, as job opening durations remained higher than other countries between late 2020 and early 2021. The reopening of economies helped to bring down the job opening duration significantly but the trajectory has reversed with a marked jump since the second half of 2021 across a majority of sectors.

Figure 20. Average Job Opening Duration by Sector (3-month Average)

![Figure 20. Average Job Opening Duration by Sector (3-month Average)](image)

Source: Citi Global Data Insights, LinkUp

Figure 21. Average Job Opening Duration by Country (3-month Average)

![Figure 21. Average Job Opening Duration by Country (3-month Average)](image)

Source: Citi Global Data Insights, LinkUp
As shown in Figure 22, this story is broadly echoed by indications from survey data for the advanced economies. U.S. small businesses and euro-area industrial and services firms appear to be facing very tight labor market conditions. The situation in Japan looks to be a notch less challenging, but the labor market there is showing less slack than in 2020.

Figure 22. U.S., Euro Area, Japan: Survey-Based Labor Shortages (SD) (3Q 2021)

These labor market challenges appear to be driven by a broad set of factors. One key contributor has been the tectonic shift in consumer demand toward goods, which has left the producers of goods scrambling to keep up. This, in turn, raises questions about whether workers have the right skills to fill the jobs. Some of the labor market tensions likely also reflect continued overhang from the pandemic — with some people hesitant to return to employment until the virus has more fully abated. Other workers have retired, or households may have decided to get by on one income rather than two. And, as noted above, the large stock of household saving is allowing workers to be more selective in the jobs that they accept.

This discussion of labor market “tightness” is especially notable for the U.S., where employment is still down by roughly four million relative to pre-pandemic. But whatever the causes, labor markets in many countries around the world are struggling to supply the labor that firms are demanding. How this imbalance eventually resolves will be a key factor shaping supply chains, and economic performance more generally, in 2022.

6. Commodity Shocks Have Amplified Other Supply-Side Pressures

After falling sharply early in the pandemic, commodity prices have climbed upward during the past year. Sizable gains have been recorded across a broad set of products, including oil, natural gas, coal, copper, aluminum, and many agricultural goods. Global commodity producers have clearly struggled (or chosen not) to keep up with rising demand. Energy supply shortages and subsequent surging prices were at the center of it all, with ripple effects globally and along various value chains.

This run-up partly involved Chinese coal prices (Figure 23), where the authorities’ long-standing safety and environmental checks, with the goal of improving the coal mining sector, have constrained coal production. But with goods demand surging globally and industries in China ramping up production, especially when COVID19 more severely affected production in many manufacturing centers globally, the unexpected outcome was a severe power shortage.
This power shortage in China was partly due to a shortage of coal supply but also local officials’ requirement to meet existing environmental goals from more senior levels of government. Power cuts affected domestic manufacturers, which also restrained the country’s exports and economic growth. The resulting disruptions cascaded broadly across the global economy, as China curtailed production of intermediate goods and other commodities, such as aluminum and magnesium. China produces around 85% of the global magnesium supply, and it is critical for autos production. The magnesium price surge and threat of shortage was so acute that the subject rose to the level of the EU Council, with “far-reaching ramifications on entire European Union value chains.” In response to power shortages on industries, its economy and people’s livelihoods, the Chinese government eased its restrictions on coal supply, allowing sharply increased coal production, thereby mostly resolving the power shortage problem.

The authorities also successfully targeted a reduction in the domestic coal price. This vigorous response has allowed coal production to pick up and the price of coal to fall, both within China and in other markets. Notably, as of November 2021, coal prices in Europe and Australia are now down 46% and 41%, respectively, from their recent peaks.

In parallel, Europe has faced spiraling natural gas prices (Figure 24), which has led to production curtailments of some industrial segments that are dependent on natural gas as a fuel or feedstock. At one point, daily data on industrial demand for natural gas pointed to a more than 20% decline in many parts of Europe. Some governments even came to the rescue of fertilizer and food production plants, to ensure the security of food supply.5

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5 https://www.bloomberg.com/news/articles/2021-09-21/u-k-has-deal-to-reopen-fertilizer-output-easing-co2-crunch
The natural gas price surge and supply shortage reflected multiple underlying factors — including fears of a cold winter, uncertainties regarding the availability of Russian supply, disruptions in wind production, shortage in hydro electricity generation, and lean inventory levels of multiple energy commodities, including natural gas and competitive fuels such as coal.

As of early December 2021, such concerns have recently moderated a notch, which has allowed gas prices to fall back slightly from their early-October peak. Even so, these worries have not entirely disappeared, and prices remain at historically elevated levels. Price spikes could very well return in the future with regular enough frequency, due to both the effect of weather on renewable energy and the reduced investments in traditional energy in securing spare energy capacity. Weather events do not need to happen in Europe to affect Europe, given the interlinkages and substitutions within the energy sector globally. Meanwhile, cutbacks in fossil fuel supply investments and retirements of existing fossil fuel or nuclear power plants, would reduce the kind of spare capacity that keeps markets from tightening and prices from surging suddenly.

![Figure 24. European Gas Inventories and Prices (as of November 2021)](image)

The upsurge and volatility in global commodity prices has contributed significantly to supply chain tensions by increasing the costs of production. In China, commodity pressures disrupted production entirely for some sectors. Commodity tensions have also increased fuel costs in shipping. In this regard, China’s response to the coal shortage has been critical in helping to relieve stresses and restore production.

Going forward, improvements in the energy price picture, including likely lower oil, natural gas, coal, and electricity prices, should be a key factor that is likely to contribute to an easing of supply chain pressures during the first half of 2022. Our sense is that global oil prices are likely to peak in coming months if not already, and be on a distinct downward trajectory by the spring of 2022.

Oil prices should ease as supply looks to rise faster than demand in 2022, with the help of higher production from the U.S. and select other non-OPEC countries, in addition to the gradual easing of the OPEC+ production cuts. Natural gas and coal prices, which are subject to their unique supply-demand drivers, should fall as well, as their respective supplies should rise. Lower natural gas and coal prices, along with a likely recovery in hydro reservoir levels and wind speed (the latter based more on a reversion to the mean for now), should help lower electricity prices.
A Snapshot of the Current Situation

Given the deeply microeconomic features of these supply chain challenges, the available macro data offer only an imperfect lens for assessing the current state of play. Even so, taken together, these data highlight several observations that merit consideration.

**Wait Times at Ports Still Higher than 2020**

Leveraging shipping data from Contguard, Figure 25 below confirms the bottlenecks spread across the globe with the significant escalations in average wait time seen in the US, Asia, South America and Middle East. Most of the ports have reported double-digit increases in terms of average stop duration by shipment when comparing 2021 to 2020.

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6 Contguard (https://www.contguard.com) is a global monitoring company that offers an end-to-end service for managing goods in transit and helps monitor and track billions of dollars' worth of shipments across a multitude of global routes.
In addition to longer wait times at ports, the average percentage of idle time per shipment (As depicted in Figure 26), which is useful data for corporates to optimize inventory levels, has also witnessed a marked jump since the second half of 2021.

Figure 26. Average Idle Time Per Shipment (%)

Source: Citi Global Data Insights, Contguard

Figure 27. Global Container Shipping Costs (as of November 2021)

Source: Citi Research, Freightos
The striking conclusion from Figure 27 is that several measures of global shipping costs remain elevated, many times higher than their pre-pandemic levels. This is especially true for container shipping from China to the U.S. West Coast, which has been the center of the storm. As shown in Figure 28, the Port of Los Angeles has seen a glut of empty containers over 2021. The situation has reflected surging U.S. demand for Chinese goods, but only limited Chinese demand for U.S. goods. Once the containers arrive at the port, there is nothing to put in them to send back to China.

But to be clear, some glimmers of good news have also emerged as of late November 2021. First, a recently imposed penalty on containers lingering in the port seems to be getting traction. High-frequency data show a 12% decline in containers at the Port of Los Angeles since early November when the fee was proposed, while boxes dwelling nine days or longer have fallen over 30%. Similar trends exist at the Port of Long Beach, where containers in port for nine days or longer are down by 33% since early November. Second, as displayed in Figure 29, the number of container ships at anchor in Los Angeles/Long Beach has fallen significantly at the end of November and has reversed most of its autumn run up. This decline suggests that efforts to clear the ports are making progress. Third, as highlighted in Figure 27, container shipping costs from China to the U.S. West Coast have also recently stepped down. Finally, these ports are currently operating above pre-pandemic levels. The main challenge is not a lack of through-put but, rather, the overwhelming strength of demand.

Notably, elevated container shipping costs are not unique to the U.S. West Coast. Costs from China to Europe are also sharply elevated (probably reflecting competition for containers at Chinese ports). And shipping costs from Europe to the U.S. East Coast are much higher than pre-pandemic. As a more encouraging development, the Baltic Dry Index, a key measure for transporting many commodities, has fallen sharply in the last few weeks of November. We see this as reflecting the slowdown in China, and also pointing to some possible attenuation of pressures for bulk commodities, particularly iron ore.

7 We understand that the ports recently modified some features of their reporting of these data, so the recent moves in this series should be interpreted with caution.
Taken together, these shipping data suggest that, while supply chain tensions remain intense, they have stopped getting worse — and may even be showing early signals of resolution. That said, it is not clear how much comfort to take from this observation. The sweep of the data seemed to suggest a similar leveling off of stresses around June 2021, but the onset of the Delta variant created a fresh round of disruptions. A related, and more hopeful, point is that recent tensions may have been amplified by peak seasonality in shipping demand as firms work to fill their shelves ahead of holiday-driven demand. An easing of these seasonal pressures, coupled with a week-long pause in Chinese production during February 2022 for the lunar New Year celebration, could support a further de-escalation of pressures.

Another window into the current state of play is offered by global purchasing managers’ indices (PMI) data (Figure 30, Figure 31, and Figure 32). Supplier delivery times for manufacturing firms remain unusually long but, at least, they have not deteriorated since July 2021. Moreover, manufacturing firms still seem to be experiencing significant backlogs, and input prices after surging through much of 2020 remain elevated. The broad conclusion from these PMIs is similar to that above — the situation is challenging but probably not getting worse. But by the same token, they also show no evidence of marked improvement.

The story that emerges from inventory data supports a similar narrative. As a relatively upbeat indicator, the global PMIs for finished goods inventories suggest that the situation in a broad group of countries is somewhat less severe in late 2021 than in previous months (Figure 33). But data on U.S. inventories, Figure 34, look more concerning. Retail automotive inventories relative to sales are down sharply compared with the years before the pandemic. But in addition, other retail inventories are also significantly reduced. Finally, “nonfarm” inventories (i.e., aggregate inventories across the economy) have hovered near historical norms, but they look to be lifted in part by build-ups of some intermediate goods as manufacturing firms await delivery of other, supply-constrained inputs.
Consistent with these observations, global automotive inventories (Figure 28) have registered a cumulative destocking of 10 million units since March 2020, and global auto sales have just recently moderated to roughly match production. As has been documented elsewhere, the continuing shortage of semiconductors has been the binding constraint on auto production. Our view is that auto chip supply will gradually recover in 2022 from the severe tensions recorded during the second half of 2021, but the challenges facing the sector are unlikely to fully abate in 2022.

**Figure 33. PMI; Stocks of Finished Goods (as of September 2021)**

Source: Citi Research, IHS Markit, BEA, Census, Haver, Bloomberg

**Figure 34. U.S.: Inventory/Sales Ratio (as of August/September 2021)**

Source: Citi Research, Census, BEA, Haver

We expect auto chip supply to gradually recover in 2022 but challenges are unlikely to fully abate.
When and How Do These Tensions Unwind?

The central question, of course, is when (and how) these tensions unwind. Given that their severity and persistence has represented a first-order surprise to most macroeconomists, this is an inherently challenging question. It was easy to say early in the pandemic that “demand is running ahead of supply” and that it will “take time for supply to adjust.” But what we are currently experiencing is qualitatively more severe. In many ways, the unforeseen — and unprecedented — nature of these disruptions echoes the unexpected challenges that arose during the pandemic and, for that matter, during the global financial crisis. In those cases, markets and analysts also struggled to understand the full dimensions of the shocks, their effects, and the features of their unwinding. Thus, our ability to comment meaningfully on how the current situation resolves hinges on whether we have sufficiently recalibrated our frameworks to understand the nature of the episode that we are now experiencing.

With a significant dose of humility, and without sticking our necks out too far, we put forward several observations that may shed light on when the situation will improve.

First, sustained progress on resolving the supply chain disruptions is critically tied to further improvement with the pandemic. As discussed, the Delta variant has throttled the global economy, softening the recovery in services spending and throwing demand back onto goods. Further the public health steps to fight the delta variant in Asia disrupted production of key manufacturing goods. Notably, the recent arrival of the Omicron variant underscores that such risks persist. To the extent that the pandemic continues, episodic disruptions in economic activity are likely to be repeated. The precise contours of each episode may differ, but further disruptions to production and consumption patterns are likely. As a related point, the resolution of supply bottlenecks will require a much smoother cadence in underlying trade flows. The global inventory system was not constructed to absorb the highly uneven stops and starts in demand and production that have followed the multiple waves of the virus.

One favorable point in this regard is that vaccination campaigns are continuing in countries across the globe, and they will get further traction in 2022. This progress is especially apparent in the emerging and frontier markets, especially those in Asia, which play critical roles in global supply chains. As the recent concern with the Omicron variant highlights, vaccinations have not provided absolute protection against further waves of infection, but they do seem to have reduced the severity. In addition, there is good reason to believe that the vaccines could be adapted reasonably quickly to respond to a troublesome new variant. All this creates a narrative suggesting that the public health backdrop should gradually become more supportive.

A second key point relates to the observation that these supply chain disruptions do not flow from just one causal factor but, rather, from several related coincident shocks. Given the varying nature of these shocks, we expect that different features of the disruptions will unwind at differing paces. With this in mind, our sense is that by the spring of 2022, several aspects of the disruptions will have improved, but the situation probably will not be fully back to “normal.”

On the positive side of the ledger, the U.S. ports have been a key bottleneck in these global disruptions. The unexpected strength of U.S. goods demand coupled with labor shortages, especially for drivers, has left the ports with historically high congestion.
This has been reinforced towards the end of 2021 by seasonal factors that have pushed up trade flows — firms are seeking to fill their shelves ahead of the holiday season.

Finding the necessary drivers to clear the ports may require strong action, for example, state governors may need to call out the National Guard to support the functioning of the ports. As a notch less aggressive approach, the Biden Administration is pushing the ports to find ways to operate around the clock until the situation improves. There also could be a relaxation of rules governing the hours of service of freight truck drivers. Such efforts may not be permanent solutions, but they would help relieve the extraordinary backlogs. Along with an easing of seasonal flows and an eventual cooling of goods demand, such steps should reasonably allow the situation to move to better balance during the first half of 2022. The recent drop in shipping costs from China to the U.S. West Coast, as well as the reduction in the number of vessels waiting offshore hints that some of these attenuating factors may already be in play.

Another positive factor, as we discussed above, is that the tone of energy markets is likely to show improvement by the spring of 2022. Chinese coal prices have already come off the boil as the government has softened its environmental restrictions (at least for the time being), and increased oil supply is also likely to be appearing in global markets through the period.

In contrast, the semiconductor market is looking more mixed. On the one hand, the evidence suggests some improvement in the memory chips used in computers. But the adjustment for auto chips is likely to continue to lag. While performance in 2022 should be more favorable than 2021’s sharp contraction, production levels are poised to remain well below pre-pandemic, which is unlikely sufficient to replenish auto inventories, given the sharp drawdowns that have occurred.

That said, as we look into next year, we also see a number of lingering unknowns that will importantly shape prospects for supply chain performance. Perhaps the central questions are how strong does the underlying demand for goods prove to be? And how long can global goods demand, especially for durables, keep up such a blistering pace?

We see several underlying vulnerabilities on this front, which could influence the picture appreciably. While we continue to expect that 2022 will bring some substitution from goods back to services, as people feel more comfortable with the public health situation, the open question is how vigorous is that substitution? Our working hypothesis is that it will be strong enough to significantly slow the growth of goods spending. But to the extent that the adjustment is somewhat sharper, and results in outright reductions in goods demand, the current pressures on supply chains could be much reduced. Conversely, if such rebalancing is delayed, or weak, the situation could be more prolonged and severe than we currently assess.

A related issue is what happens to the path of inflation. A sustained upward move in inflation could cut into real wages (and thus restrain consumer expenditure), or motivate central banks to remove monetary stimulus more rapidly. Either of these outcomes could result in weaker aggregate demand and, specifically, a cooling of spending on goods.

While supply chain disruptions, coupled with rising commodity prices, have been prominent drivers of inflation in 2021 (as manifest by surging PPIs in countries around the world), we do not see these pressures as the most probable source of inflation going forward.
Rather, to the extent that inflation persists in 2022, it is likely to be driven by pressures on services prices, as the sector recovers from its pandemic-induced weakness. The adjustment in the services sector will depend critically on the availability of labor, as well as on the flexibility of the jobs market more generally.

Several other issues are also important. First, as we have discussed, households are currently sitting on trillions of dollars of “pent-up” saving. And we simply do not know how this massive accumulation of resources will be deployed. No doubt some of it will be held as a precautionary buffer, as households have likely concluded that the world is a more uncertain place than they previously believed. In addition, some fraction will likely be used to further pay down debt or finance retirement. But we continue to judge that that some portion of this saving will be used to fund expenditures and, thus, will boost consumption over time. Whether this spending falls principally on goods or services remains an important open issue.

Second, while we see scope for extraordinary measures for obtaining the labor needed to unclog the ports, there is a deeper question about how long labor shortages will persist, especially in the U.S. and the ASEAN countries. To the extent that the labor market is more scarred, and these shortages prove long lived, this could both forestall the clearing of current supply chain tensions and soften economic growth going forward.

Third, it is possible that the current supply chain disruptions are, at least in part, a manifestation of two critical types of disinvestment. The evidence of inadequacies in U.S. infrastructure, including ports, has long been apparent. An open question is to what extent the current disruptions in the U.S., which are playing a critical role globally as well, reflect massive cumulative deficiencies in public investment. This is an issue that we are thinking about and watching closely. The recently approved “bipartisan infrastructure framework” is a step forward in addressing this gap, but its effects will be felt only gradually over years and, in any event, it is probably not sufficient to reverse decades of neglect.

Similarly, as discussed above, the equity market clearly has not rewarded capital-intensive industries and technologies, including some that are critical links in goods production. The result has been an outsourcing of these activities to the extent possible and, likely, an underinvestment in such activities. While the current episode may shift the investment priorities of manufacturing firms, as well as the attitudes of market participants, any resulting effects will come online slowly over time.

Bottom line, our expectation is that supply chain tensions are likely to be a notch less acute by the spring, but there are enough lagging elements and structural uncertainties, that it is hard to believe that circumstances will be back to “normal” until well into 2022 or, perhaps, even beyond.

We expect supply chain tensions to ease slightly by early in the second quarter of 2022, but a return to “normal” is unlikely until well into 2022 or beyond.
Concluding Thoughts

The implications of this extraordinary episode are likely to shape the contours of the corporate sector’s supply chain management strategies in the years ahead. Given the vulnerabilities that have been exposed, many firms will no doubt feel obliged to review the pandemic’s lessons and make adjustments in their operations. What these adjustments will ultimately look like remains to be seen, but the following are some early thoughts as to what might be in play.

One likely outcome is a further embrace of digitization and electronic tracking of inventories and logistics. This should allow firms to more accurately track and project the granular details of inventory requirements and better manage the accompanying logistics. Such efforts would also support automation, potentially including robotics, and reduce error rates. The ultimate goal is to deploy key classes of information more efficiently to facilitate production and, in the process, make inventory management more robust to shocks. While meaningful progress has been made in these areas in recent years, there is still significant work to be done, especially in the small business sector.

As a more old-school approach, firms may also place greater emphasis on long-term alliances and partnerships with their suppliers. Such efforts would be a step away from the “rough and tumble” cost-minimization approaches that have often prevailed in recent decades. Implicitly at least, a move in this direction would require exchanging a degree of cost efficiency for increased reliability.

Even so, closer long-term relationships would offer firms greater confidence that suppliers would prioritize producing and shipping their inputs during a time of stress. Longer-term partnerships would also benefit suppliers by stabilizing the path of demand for their products. Similar outcomes could also be achieved by increased reliance on long-term contracts. Notably, such solutions might reasonably motivate firms to prioritize relationships with suppliers that offered financial strength (to operate through shocks), flexibility (to respond to the firm’s evolving needs), and reasonable proximity (to simplify logistics). Notably, this set of considerations is considerably broader than just the contracted price.

A third option is that firms may shift their inventory management strategies, at least a notch, toward holding larger buffers as insurance against adverse events. This could be done across the board or focused strategically on holding larger quantities of inputs judged especially vulnerable to disruption or critical to the overall production process. Weighed against the potential costs of production stoppages, which seem more palpable than a few years ago, the carrying costs of larger inventories might be well justified.

But there are other dimensions of this issue to consider as well. In recent years, broad economic and policy developments have highlighted to firms that far-flung, complex supply chains carry unexpected risks. This point was highlighted by President Trump’s trade wars. As tariffs were imposed, inputs from China were suddenly more expensive than before. Similarly, sanctions strategies have cut some firms off from the global marketplace, at least temporarily, and disrupted trade flows to other firms dependent on their products.
Global uncertainties may motivate firms to simplify supply chains and bring them closer to home.

Governments may look at further global integration more skeptically.

Where the trade wars left off, the pandemic picked up. As the global economy reeled from lockdowns and production outages, firms were left short of inputs and uncertain about the path of demand. This episode underscored that the world is an unpredictable and risky place, and the farther supply chains get from home, the more vulnerable they become to a range of foreseeable (and unforeseeable) shocks.

All of this may motivate firms to simplify their supply chains and bring them closer to home. For the U.S., this could mean less production in China and more in nearby countries such as Mexico — and perhaps more production domestically in the U.S. as well.

While the wind is likely to blow in this direction in the years ahead, we see two notable countervailing factors. First, there are good reasons why so many firms have come to source their inputs in China. Chinese producers have provided an attractive mix of reliability, flexibility, and cost effectiveness. These attributes may prove sufficiently robust to offset amplified risks of sourcing from China. For example, firms may continue to rely on China and simply hold larger inventories to guard against any attendant risks. Second, even if supply chains do return to the United States, the realities of U.S. manufacturing mean that they are likely to return in highly automated forms. Hence, the accompanying macro impulse may be more evident in investment, rather than in employment.

Finally, as a geopolitical matter, the pandemic has further called into question the inevitability of deepening global integration. The policy steps required to fight the virus have highlighted the role of nation-states in protecting the health and welfare of their citizens during times of stress. As such, this episode has reinforced already existing concerns that globalization was stoking inequality.

As the pandemic emerged, national borders were closed, transportation and travel were disrupted, and people looked to their national government for a response. The longer-term implications of this episode for governments as they manage the economy are still to be seen. But it is reasonable to expect that, at least for now, they will look at further integration with a more skeptical eye. And it is likely that they will take steps to protect their economies from similar events in the future.

For example, in the name of essential security, governments may now require the domestic production of goods that are judged important for the health and safety of the public, including pharmaceuticals and other medical products. For different reasons, countries may reach a similar conclusion about semiconductors and other elemental parts of manufacturing supply chains. The extent to which any re-profiling of supply chains that results will represent an efficiency loss for the global economy — versus prudent risk-management measures — will depend on the scope of these initiatives and the frequency of such disruptions in the future.

Using corporate filings, press releases, and transcripts over the last two years globally, Figure 36 below summarizes the top 15 industries where companies have reported supply chain issues with the most negative sentiment. In the sections that follow, we examine some of these industries in depth in terms of supply chain challenges and how they move forward from here.
Figure 36. Total Number of Corporate Documents Mentioning Supply Chain Issues, by Industry

Source: Citi Global Data Insights, AlphaSense
A Look at Selected Sectors

Transportation and Shipping: Congestion Is Prevalent

Congestion has become a dominant theme when looking at the supply chain through the lens of the global transportation and shipping industries. Evidence of supply chain pressure is clear at ports globally, but it is most obvious in the U.S., and at Los Angeles/Long Beach specifically. During November 2021 the number of containerships anchored or adrift off the southern California ports has hovered above 70 vessels, reaching above 80, but has fallen off steeply starting at the end of November into December. Normally there is no wait for vessels calling on the port complex and as recently as July 4th there were fewer than 10 ships queued up for a terminal berth. As strong ordering ahead of the holiday season built up and inland transportation service struggled over the summer, congestion at the ports grew and currently is still elevated.

While the southern California ports are the focal point of the supply chain crunch, we are seeing similar congestion trends in container shipping around the world. Congestion at Asian ports is up 30%+ over the last 6 months and globally congestion is up 10%+ over the same time period, with 37% of the global containership fleet waiting at/near dock in November 2021. That said, issues in China related to power shortages appear to be manageable, with some stabilization noted recently.
Rate Inflation Is the Result

We are seeing signs of congestion filter through the global supply chain in the form of higher rates. Ocean rates from Asia to the U.S. exemplify this dynamic with spot rates spiking from ~$2,000/box pre-pandemic, to more than $20,000/box at the peak in September 2021 before easing a bit to $14,885/box as of mid-November. In the U.S., truck rates speak to tight supply (mainly from a lack of drivers), with average spot rates up 24% YoY and average contract rates up 26% year-over-year.

Too Much of One and Not Enough of the Other Two

Underlying factors include high demand for imported goods, and short supplies of labor and port-side land

Demand...Labor and Land

We think there are three underlying issues at the heart of the current supply chain disruption, particularly from a U.S. perspective. The first is demand. Demand for imported consumer goods has grown since the beginning of the pandemic as much of the U.S. consuming public saw expenses reduced and services spending was re-routed toward goods. This has resulted in a 25% year-over-year spike in imports through the ports of Los Angeles/Long Beach through September 2021. Looking back to pre-pandemic periods, 2021’s import activity in southern California is up 21% from 2019 and up 18% from 2018, which was a strong year for freight.
So while there has been robust demand, there has not been a commensurate increase in labor and land. On the labor front warehouse workers have grown by 5.9% on average in 2021 and trucking employment is up 2.4%, but trucking is actually down from pre-pandemic levels. Warehouse and truck drivers are in tight supply and are experiencing fierce competition, particularly among parcel and ecommerce delivery/fulfillment jobs. This is yielding an employment growth rate in these sub-sectors which is too low to keep up with demand, particularly in trucking.

Job Postings Illustrate the Mismatch

The labor/demand mismatch is further illustrated through looking at the percent of U.S. job postings by company, where the demand for laborers and material movers experienced spikes at the beginning of the pandemic, as well as the most recent data month of October 2021. The general demand for these workers has also been significant trending upwards since the pandemic. On the other hand, the demand for truck drivers also surged in April-May 2020, which was likely a result of the plummeting employment figures in this occupation group.
Finally, port-side land is also in short supply, particularly in densely populated regions like southern California. Land is necessary to stage containers when operations get congested. Most trucks arriving at the port have an empty container to unload, which needs to occur in order to pick up a loaded container. But with terminals at/near capacity the port has run out of room to put empty containers. So without incremental storage facilities, it is difficult to keep volume through the terminals fluid.

**Putting Congestion in Perspective**

While headline congestion data is still elevated, particularly the high profile number of vessels at anchor off Los Angeles/Long Beach, we think there is more to the story than just that. First off, as we previously noted, imports are running at record levels with volume up 25% year-over-year and nearly 20% above the last strong pre-pandemic year (2018). There is no doubt that volume could be better, as highlighted by the 500,000+ TEUs (twenty-foot equivalent unit) on ships at anchor off of southern California, but volume is still moving. Rail carloads are running just below 2019 levels while less-than-truckload (LTL) shipments are running at record levels. Truckload fundamentals are also robust with demand outstripping lower capacity from fewer drivers to push rates to all-time highs.

In addition, there have been a number of measures put in place by the ports which may be showing early signs of improving terminal throughout. Notably, a threatened penalty on containers dwelling in the port for extended periods appears to be having some positive impact on fluidity. Containers in terminals at the Port of Los Angeles have fallen by 12% in total since early November 2021, when the fee was proposed, while boxes dwelling nine days or longer have fallen 31% since November 1st. Similar trends exist at the Port of Long Beach, where total containers in port for nine days or longer are down 33% since November 1. Along with measures the state of California has taken to free up open land for empty containers and the potential for underutilized rail throughput to improve, we think the lower container dwell could be an early sign of decongestion progress.
Figure 48. Port of Los Angeles/Long Beach Container Dwell

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<td>31,497</td>
<td>28,122</td>
<td>27,744</td>
<td>31,644</td>
<td>37,446</td>
<td>33,379</td>
<td>38,437</td>
<td>18.5%</td>
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<tr>
<td>5 to 8 days</td>
<td>12,278</td>
<td>11,792</td>
<td>10,436</td>
<td>9,171</td>
<td>10,649</td>
<td>12,949</td>
<td>10,920</td>
<td>11,566</td>
<td>10,065</td>
<td>9,442</td>
<td>7,758</td>
<td>(5.0%)</td>
</tr>
<tr>
<td>9 to 12 days</td>
<td>11,150</td>
<td>8,474</td>
<td>7,516</td>
<td>7,669</td>
<td>7,131</td>
<td>6,071</td>
<td>5,980</td>
<td>8,392</td>
<td>8,009</td>
<td>5,844</td>
<td>6,231</td>
<td>(34.6%)</td>
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<tr>
<td>13+ days</td>
<td>31,127</td>
<td>28,243</td>
<td>26,704</td>
<td>26,106</td>
<td>25,802</td>
<td>23,202</td>
<td>18,817</td>
<td>20,857</td>
<td>18,964</td>
<td>17,989</td>
<td>18,171</td>
<td>(39.0%)</td>
</tr>
<tr>
<td>Total</td>
<td>86,945</td>
<td>78,131</td>
<td>71,493</td>
<td>77,710</td>
<td>77,079</td>
<td>69,504</td>
<td>64,501</td>
<td>76,613</td>
<td>70,985</td>
<td>66,227</td>
<td>72,283</td>
<td>(12.2%)</td>
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<tr>
<td>Longer Dated (9+ days)</td>
<td>42,277</td>
<td>36,717</td>
<td>34,020</td>
<td>33,775</td>
<td>32,933</td>
<td>28,373</td>
<td>24,797</td>
<td>29,249</td>
<td>26,973</td>
<td>23,833</td>
<td>24,401</td>
<td>(17.9%)</td>
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<tr>
<td>as index</td>
<td>100</td>
<td>87</td>
<td>80</td>
<td>78</td>
<td>76</td>
<td>72</td>
<td>62</td>
<td>69</td>
<td>64</td>
<td>56</td>
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<tr>
<td>Local 9+ Days</td>
<td>28,358</td>
<td>20,633</td>
<td>19,540</td>
<td>19,954</td>
<td>21,723</td>
<td>18,345</td>
<td>16,739</td>
<td>18,029</td>
<td>17,878</td>
<td>17,771</td>
<td>17,771</td>
<td>(34.9%)</td>
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<tr>
<td>as index</td>
<td>100</td>
<td>73</td>
<td>69</td>
<td>71</td>
<td>77</td>
<td>62</td>
<td>59</td>
<td>67</td>
<td>65</td>
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<tr>
<td>Container Dwell in Days</td>
<td>70,635</td>
<td>57,350</td>
<td>53,560</td>
<td>53,769</td>
<td>54,767</td>
<td>45,012</td>
<td>35,722</td>
<td>48,279</td>
<td>43,708</td>
<td>40,352</td>
<td>42,378</td>
<td>(16.9%)</td>
</tr>
<tr>
<td>as index</td>
<td>100</td>
<td>81</td>
<td>76</td>
<td>76</td>
<td>77</td>
<td>68</td>
<td>59</td>
<td>68</td>
<td>66</td>
<td>57</td>
<td>57</td>
<td>57</td>
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Source: Citi Research, Port of Los Angeles, Port of Long Beach

We think further measures by the government to potentially ease hours of service rules around freight truck drivers would be helpful in further aiding fluidity. As would opening government property for empty container storage.

Path Forward Leads to Inflation of Transport Rates

Ultimately, we believe supply chain congestion is likely to linger well into 2022, but the combination of seasonality through the first quarter and Chinese New Year, and significant focus from industry and government participants on improving fluidity is likely to mean that progress can be made from here. In other words, we do not expect congestion to get worse. If we are right, we would expect to see greater freight volume and fluidity aiding inventory levels through 2022. Nevertheless, transportation capacity is likely to remain tight which should support materially higher freight rates throughout 2022. We would also expect to see inflationary pressure on freight transportation workers’ wages.

We see the most obvious financial impact to the large liner shipping companies where balance sheets will improve from a historical profit cycle boosted by elevated rates and utilization. We also see tailwinds to rail and intermodal profits and balance sheets. We do not expect just-in-time inventory strategies to change to just-in-case. It is possible that the windfall of profits, particularly for large liner companies could lead to M&A designed to vertically integrate supply chain provides across modes of transportation.
Global Autos

Latest Supply Chain Assessment

The global auto sector has been hit hard throughout 2021 by global supply chain shortages. There were a number of factors in play, ranging from direct semiconductor shortages (beginning in the first quarter of 2021), a fire at a major supplier plant in Asia and weather-related disruptions in the second quarter, and COVID-related challenges in the second half of the year.

The bulk of these disruptions occurred in second and third quarters of 2021, when companies were at times reporting daily disruptions to their vehicle production schedules. The good news is that the final quarter of 2021 appears off to a better start with production slated to recover modestly off the previous quarter lows, though companies are still reporting generally poor visibility versus historical norms.

All told, the tally of lost 2021 global light vehicle production is expected to reach ~10 million units versus original forecasts at the start of the year — amounting to an industry revenue impact in the hundreds of billions of dollars. By region, North America is expected to absorb over 3 million units of this shortfall, Europe at just under 3 million and China at 1.8 million.

The outlook for 2022 is mixed, with the first half of the year expected to experience continued supply tightness (at a very gradually improving pace versus the second half of 2021) and the second half expected to recover more meaningfully. Compared with industry expectations at the start of 2021, global light vehicle production in 2022 is still expected to fall ~6 million units shy of expectations, though on a year-over-year basis 2022 should amount to a modest 9%-10% recovery.

Figure 49. Light Vehicle Production Changes (2021-2023)

Source: Citi Research, IHS
Several Industry Implications

In addition to lost auto production volume and associated industry revenue, the global auto industry experienced a number of other implications from this crisis:

Higher supplier decremental margins: Auto suppliers typically enjoy relatively good near-term visibility with respect to their automaker customers’ production plans — meaning that sudden surprises are typically rare. This allows suppliers to better manage their own plant/labor costs to maximize efficiencies when production volumes change. However, when that visibility is no longer available and production disruptions do become sudden (as they have in 2021), it becomes far more difficult to manage costs down. As a result, the supply chain is forced to absorb significant inefficiencies that show through in higher decremental margins on lost revenue and therefore lower operating margins. One of the items on the supplier 2022 wish list is for production schedules to return to a smoother cadence, even if absolute unit production does not return to normal.

Significant cost pressures challenging traditional industry model: On top of the added production volatility, the industry has been forced to cope with higher commodity, transportation/freight and energy costs. Combined, these have probably added well over $1,000 to the cost of a vehicle in the third quarter — though this number can vary. Historically, the auto industry has successfully mitigated inflationary pressures through various cost offsets. However, current pressures have seemingly overwhelmed these mechanisms at least through the short term. In response, the industry has implemented both short- and long-term mitigation initiatives. And as noted below, it’s proving quite helpful that auto demand — and therefore pricing — have remained very strong through this period. In the case of commodity costs, suppliers have relied on various pass-through mechanisms with automaker customers, who themselves are enjoying stronger pricing thanks to very tight supply/demand. In addition, suppliers have also benefited from a richer mix of content, as automakers tend to leverage content-mix to drive higher pricing. Still, these offsets have not proved sufficient to offset all cost pressures. In response, the industry has worked to cut costs through various product redesigns, corporate cost-cutting measures (though not as severe as COVID-19-related cuts in 2020), and commercial discussions. All of these initiatives inherently assume that some of the current industry cost pressures will prove transitory. In the event that they do not, suppliers have begun hinting at alternative proposals including the possibility of automakers providing committed volume to the supply base. Whether such long term initiatives are ultimately required — and whether they can actually be implemented—remains to be seen.

Very tight supply/demand leading to strong vehicle pricing: Through this supply chain crisis, automotive demand has shown no signs of slowing down. In fact, in the U.S. we believe that COVID-19 likely created additional auto demand by virtue of de-urbanization and some shifting away from public transportation — trends that have been evident in our proprietary survey work. Said differently, we believe that upward pressure currently exists on the ratio of U.S. vehicles/household. To achieve a higher level of vehicles/household, the current U.S. installed-base of ~280 million vehicles would need to increase. The way it would achieve that increase is through robust new vehicle production, but that of course has been very constrained in 2021 with North America production expected to run at ~13 million units. Scrap, which reduces the installed base, still appears to be running at an annual pace of 12 million-14 million vehicles. So what we end up with is a situation whereby the installed base wants to grow but the supply is not there to accommodate it, and yet the downward pressures on that installed base continue to persist. The implications of these have been felt in a number of areas, including the following:
Strong new vehicle demand with automakers seemingly selling everything they can make and recent U.S. monthly unit volume consuming >90% of incoming dealer inventory (versus ~40% historically). Entering November 2021, U.S. dealer inventory is running at ~1 million units (versus a typical ~3.5 million observed during recoveries).

With tight new vehicle inventory, automakers are experiencing very strong U.S. vehicle pricing (+$4k versus 2020) and lower incentives. This has allowed automakers to offset, and in some cases, more than offset inflationary pressures to deliver strong margins. That said, the automakers too have been increasingly struggling on the price vs. cost side, as their commodity contracts provided a lag earlier in the year that is now catching-up.

Very strong used vehicle pricing, which has benefited auto finance companies and new vehicle pricing (higher residuals).

**Importance of localization:** Obtaining supplies of chips has become a key issue, not just for automakers but for countries themselves. For auto-producing countries, amicable relations with chip producers in their own countries and with those in supplier countries are probably essential. The nurturing of the battery industry is also an imperative in automotive batteries, which are expected to spread rapidly moving forward. Aside from these issues, the rapid rise in marine shipping charges has become a major negative for those tire makers that ship products from Asia to North America. Firms are working to raise prices but they are at a disadvantage in terms of transport costs in comparison with companies that have made headway with a local production/local consumption model. The gulf between labor costs in developed markets and emerging markets has been a spur to globalization but we sense that the importance of localization has increased from the twin perspectives of transport cost savings and the stable supply of components.

**Working Capital and Balance Sheets:** For automakers, inventory de-stocking can often lead to significant working capital outflows due to the nature of the cash cycle. This was a particular source of financial stress during the 2008-09 downturn. This time around, one offsetting factor has come from strong performance at the captive finance companies — in part thanks to strong used vehicle pricing and low defaults. The financial strength at captive finance companies allowed them to pay cash dividends back up to the automotive parent, helping the parent companies absorb the working capital drain caused by the inventory de-stock. So by historical standards, the free cash flow and balance sheet impacts from this period of de-stocking were fairly mild, as the industry managed to avoid the financial stress that ensued during the 2008-09 de-stock period, thanks to strong demand, more flexible cost structures and healthier balance sheets going in. For suppliers, working capital tends to actually amount to a source of cash when auto production declines. However, this was less apparent in recent quarters as the supply chain shortages prompted suppliers to use working capital to support customers and manage the volatility.
Semiconductors

Shortages to Persist

Since the second half of 2020, we have seen a broad-based semiconductor shortage affecting downstream production of several types of products — from automobiles to cell phones to computers. Despite many headlines being devoted to the semiconductor shortages plaguing the automotive industry, many other industries have been equally affected. The shortages have been attributable to two sources. First, the normal shortages that occur in every semiconductor upturn, which has been exacerbated by COVID-19-driven shutdowns of various factories. Second, low semiconductor inventory was quickly snapped up and there was no cushion for the higher order rates. As a result, lead times for many types of semiconductors have stretched beyond a year and there appears to be no remedy in sight until the second half of 2022 at the earliest.

Semiconductor units fell 6% year-over-year in 2019 and were only up 1% year-over-year in 2020, well below the average 9% increase since 2005, which suggests that the channel inventory has been very lean for the last two years. We expect semiconductor units to grow at 17% year-over-year in 2021, and believe this current backdrop is similar to the inventory build back in 2017-18 where semiconductor unit growth reached double-digits for two consecutive years.

Figure 50. Semiconductor Unit Year-Over-Year Growth, 2005-2021E

Source: Citi Research, WSTS

Early in the pandemic outbreak, many semiconductor buyers canceled orders with production suspension on lockdown and a more pessimistic demand outlook. Orders for semiconductors from many end markets such as automobiles essentially fell to zero. The semiconductor companies responded by drastically cutting back on production and trying to lean inventory out as much as possible. The combination of massive global stimulus and work-from-home/school-from-home drove a dramatic upturn in demand for many types of electronic goods such as personal computers (PCs), which was completely unanticipated by the semiconductor food chain. The subsequent 5G smartphone ramp, with increasing semiconductor content per box, squeezed the semiconductor growth for other applications.

Prior to 2020, PC units declined 1% on average, at about 260 million units per year. Due to work/school-from-home trends, PC units grew 14% to 299 million units in 2020 and will grow another 12% to 335 million in 2021, well above the average historical decline of 1%. PCs are the largest end market for semiconductors at roughly 30% of total semiconductor revenue.
In May-2020, a new rule unveiled by the U.S. Commerce Department expanded the limitation on sales to certain Chinese companies of semiconductors made abroad with U.S. technology also resulted in higher orders. As a result, these companies started to build inventory stock before the effective date that ended semiconductors being sold to them. The addition of more companies the entity list by the U.S. Commerce Department further disrupted the supply chain. To deal with supply chain uncertainties amidst geopolitical tension, other Chinese hardware manufacturers also increased their inventory level and thus further intensified the supply chain turmoil. Moving into 2021, the lockdown in Malaysia and some South East Asia countries in response to the Delta variant breakout further affected supply. Upon rising demand and supply disruption, buyers of semiconductors were eager to build higher inventory levels across the board to mitigate any supply chain logistic issues occurring from the unexpected COVID-19-related lockdowns. Shortages, longer lead times, and rising prices have led to double ordering and inventory stocking. The inventory stocking has further enlarged the demand and intensified the shortage situation.

Semiconductor companies across the board are benefiting from the supply shortages with increased visibility, pricing, and up-front payments for future shipments. With strengthening pricing power, several semiconductor companies have increased prices during 2021. The have also benefited on occasion from the offer of more favorable payment terms to reserve scarce capacity.

As illustrated in the chart below, semiconductor pricing is now the highest since 2014. Semiconductor average selling prices (ASPs) in the third quarter of 2021 were up 7% quarter-on-quarter, well above seasonal quarterly rise of 1%. We expect 2021 semiconductor ASPs to be up 6% in 2021, well above the average 2% decline in the last decade.
New entrants also benefit from customers becoming more willing to adopt new suppliers.

The chip shortage has dealt a heavy blow to downstream supply chains, especially in the auto and consumer electronics sectors.

Cyclical shortages exacerbated by COVID and fiscal stimulus have also driven the disruptions.

The shortage has also benefited new entrants to the industry, mainly Chinese chip makers. It has provided opportunities to penetrate into larger customers that were not accessible before given it is traditionally very difficult to take share from established incumbents. Device manufacturers have little incentive to introduce new suppliers that increase the cost of testing with limited economic benefit. The Chinese semiconductor suppliers have struggled to compete with more established competitors despite the nation’s self-sufficiency objective. However, we have observed recently that hardware manufacturers are more willing to adopt new supply as a supplement amid the chip shortage, particularly for products such as power management integrated circuits (PMICs).

That said, the chip shortage has been a huge problem for many downstream supply chains, particularly, automotive and consumer electronics. Auto makers have cut production plans due to chip shortage, and the situation does not appear to be improving. It appears there will be semiconductor shortages well into 2022.

Consumer products (e.g., smartphones, PCs, tablets) have also reduced production volume on missing components. In recent quarters, many hardware manufacturers delivered lower-than-expected results due to supply chain issues and component shortages. The impact includes missed sales opportunities, lower production efficiency, and margin pressure on rising component costs. Manufacturers have dealt with suppliers to negotiate supply and commit to long-term contracts while developing second sources for supply stability.

Despite the supply and demand disruptions during the pandemic, we see the shortage as part of the cyclical nature of semiconductor industry — albeit magnified during the present cycle given the COVID-19 impact and massive fiscal stimulus. Similar situations have been witnessed in the previous cycles in 2011, 2015, and 2018, despite different cause and effects. The semiconductor market has always been cyclical given its extensive and fragmented supply chains; the time it takes to make a semiconductor (roughly three months); the obsolescence of semiconductors (product cycles can be two years which makes building inventory an expensive proposition); and enormous manufacturing costs. We believe the industry will continue to be cyclical, as it has been for the last 50 years.
On the bright side, we do not expect the severity of inventory shortages going forward unless there is another pandemic shutting down factories and snarling the supply chain.

We do not believe political intervention or policy changes will improve the situation. Instead it is only likely to spend taxpayer money inefficiently and make the situation worse, given politicians lack of understanding around the intricacies of various enterprises and industries. Providing a more predictable business environment with less political intervention could facilitate healthier industry development.

The overall supply chain tightness looks to ease some time in the second half of 2022. In a more optimistic case, the supply chain could adjust the capacity through node migration, change design with alternative devices, and capacity addition. These, together with moderating inventory stocking demand, could lead to more balanced supply demand with structural shortage in certain devices.

Nonetheless, in a more likely case, the shortage will likely ease with declining demand. Semiconductor demand could moderate further when we pass the peak of the economic cycle. The expectation for loosening supply, and therefore price declines, would lead to an inventory de-stocking, which would further depress the demand. The situation could be exacerbated by the increasing capacity, turning the shortage into oversupply, if demand falls short of projection.

With increased supply and moderated demand, we expect the shortage will be eased sometime in 2022. The shortening lead time would be an indicator for the reverse of the trend. An inventory correction, if seen, would likely lead to an oversupply situation and trigger an semiconductor down cycle.
Global Industrials

The Current State of Supply Chain Disruptions

The global industrials sector is diverse in its end markets and business models, but there are some common threads that have affected the sector over the last ~12 months.

- Supply chains have been affected by both component and material shortages: Post-COVID-19 supply chain disruptions first became evident in semiconductors. Semiconductors are everywhere but in industrial markets the key semiconductor component groups are power semiconductors, microcontrollers, connectivity chips, and sensors. These often contribute a very small percentage of the bill of material for most industrial products, but production cannot be completed without them. We have seen some outright temporary production stoppages in markets like heavy duty trucks, and longer lead times in many other markets. Beyond semiconductors, shortages in certain materials like resins (used in composites) have been exacerbated by weather effects and unexpected plant closures, highlighting that tight supply markets are at risk of exogenous events that could normally be absorbed. More recently, the energy crisis in China has led to a shortage of magnesium, often used in aluminum alloys.

- Logistics, market access, and congestion have exacerbated the issues: Port congestion in China and the shortage of containers has led to supply issues at the point of origin, further exacerbated by market access in countries that are still in high states of lockdown (e.g., Vietnam), or where port access at the point of destination (e.g. the Port of Los Angeles in the U.S.) is constrained. Many companies have commented that port congestion issues have been amplified by a lack of warehouse space and lack of truck drivers to enable onward moving of goods.

- Labor is a concern, but has caused fewer issues in 2021 compared to components or logistics: The most recent Institute for Supply Management (ISM) survey in the U.S. highlighted that manufacturing labor shortages remain an issue, although labor issues have arguably been more impactful in the supply chain (truck driver shortages) than in factories themselves.

Underlying Drivers: The Return of the “Bullwhip” Effect

In the 1990s, a supply chain phenomenon known as the “bullwhip” effect was identified — volatility in demand increased the further up the chain you went, meaning producers saw more volatility than distributors, component suppliers saw more volatility than producers, and so forth. A Massachusetts Institute of Technology (MIT) paper at the time observed that “the ordering patterns share a common, recurring theme: the variabilities of an upstream site are always greater than those of the downstream site.” Since then, industrial companies have invested vast amounts in improved demand forecasting, supply chain management and operational efficiencies, and significantly reduced this effect. The speed of the COVID-19 recession and rebound in many markets however has been so quick that the supply chain simply could not react fast enough to the rebound in demand. As the old saying goes, a supply chain is only as strong as its weakest link.

Policy has also driven disruption — U.S. trade tariffs applied in 2018 for example were already exposing supply chain fragilities even before COVID-19 struck.
The supply/demand imbalance varies by sector but we expect it to significantly normalize during 2022. While some bottlenecks are easing — for example semiconductors — we would say conditions for logistics are sequentially worse in the second half of 2021, as are certain material shortages.

**Implications**

Pricing has generally picked up even in those industrial markets that are not normally seen as having the best pricing power — in general pricing has increased to offset higher material costs although the phasing (i.e., the lag of pricing following input cost increases) and the percentage recovery varies by sector.

We have not seen a meaningful increase in inventories since everything that can be produced is being shipped, and lead times are being extended — although there is clearly a debate as to whether future working capital levels will be structurally higher. The most recent survey from the ifo Institute points to manufacturing inventory assessments picking up from the lows, but manufacturing lead times (as measured by the ISM survey) remain lengthy by historical standards. The lack of container supply, surge in costs, delays and all-round lack of reliability on delivery schedules have also helped increase demand for air freight.

Many companies have seen book/bill ratios — the ratio of orders to sales — extend to new highs as real demand (as measured by orders) remains elevated but the ability to deliver (as measured by revenue) is constrained.

The imbalance of trade between Asia and the U.S. has manifested itself in the increase in the number of empty container boxes going back from the U.S., hence the saying among observers that one of the fastest growing exports from the U.S. to Asia is air.

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**Figure 54.** The most recent survey from the ifo Institute points to manufacturing inventory assessments picking up from the lows...  
Source: Citi Research, Datastream

**Figure 55.** ...but manufacturing lead times (as measured by the ISM survey) remain lengthy by historical standards  
Source: Citi Research, Datastream
Steps to Relieve the Stress – Near Term and Longer Term

Some of the products in short supply will continue to see structural demand growth in industrial markets well beyond the 2022 or 2023 — as the Industrial Internet-of-Things (IoT) becomes more pervasive, semiconductor content will only increase; and as the world electrifies, demand for certain enabling metals for conductivity or storage will also structurally increase. We expect governments to incentivize domestic supply chains for critical components and materials. In the U.S., the Supply Chain Disruption Task Force lists semiconductors, raw materials, and batteries as three of its targeted industries. In Europe, a “European Chips Act” has been announced by the European Commission president to bolster semiconductor supply.

We have also seen (and expect to continue to see) companies forming longer-dated partnerships with logistics partners.

We expect investments in automation and digitization, already major focus areas, to increase in order to increase efficiency and information flow. We expect an accelerated pace of investment in “connected” industrial technology to be a relatively consistent theme going forward as companies remain focused on building resiliency and driving productivity gains.

In the container market, production of container boxes (mainly in China) will hit a new all-time record high in 2021 and shipping companies have also increased orders for container ships. The problem is that while the lead time for container boxes is measured in terms of weeks, the lead time for new ships is measured in terms of years. The ratio of new orders to the total fleet is at an eight-year high but it will take until 2023 before supply begins to ease. And then there is the issue of the limited capacity of container ports with lead times for new construction extending up to ten years or more depending on planning permission, environmental impact assessments (EIAs), etc.

What Does the Path to “Normal” Look Like?

We expect suppliers in key areas to add capacity through 2022, although certain product areas (like semiconductors) have long lead times. We expect some bottlenecks to ease from starting at the end of 2021 but the effects could linger throughout 2022 and into 2023.

Certain facilities are now being run 24/7, and normal seasonal slow periods may be used to rebuild inventories. The need to automate port facilities would also seem to be an absolute necessity.

Employment Implications

Automation is seeing continued growth and we think any re-shoring of manufacturing to protect against supply chain disruptions would also be highly automated. We would also expect automation penetration to increase in warehouse automation and logistics. In other areas like service, we are seeing remote servicing and other digital solutions significantly reducing the labor intensity of service for many industrial markets.
Figure 56. The industrial sector has already become much more “employee light” in the U.S. …

Figure 57. … and the real output per manufacturing employee is now four times what it was in the 1970s

Source: Citi Research, Datastream

Bull and Bear Scenarios

Bear scenarios could include any resurgence of the pandemic that force capacity or transport closures, or if government policy to protect supply chains meets with any adverse reaction like a trade war.

A bull scenario could be that market forces drive capacity additions such that bottlenecks are eased, that the resulting inflationary pressures prove transitory, and that pent-up demand from unfulfilled orders in 2021 boost 2022 growth.

Lessons

Real-time, global, diverse supply chains have massively reduced the cost of goods over the last 20 years, but arguably some of the risks have been exposed. We expect further investment in digitization (to get more information) and automation (to reduce the risk of future potential pandemics), and we also expect companies to increasingly form longer term partnerships for sourcing and logistics. We also wonder if the mantra of “just-in-time” will be replaced by “just-in-case”, with more companies carrying more inventory. Given the degree of congestion on the west coast of the U.S. (especially outside Los Angeles/Long Beach), and the lack of any near-term fix within the next 6-12 months, we wonder if some Asian exporters will re-assess their own supply chains and look to increase capital expenditure in the U.S. and also in Mexico.

To make supply chains more resilient, we expect further digitization and automation, longer term partnerships, and a possible shift to “just-in-case” inventory building.
Metals and Mining companies have both contributed to disruption and seen its impacts. Capital expenditure (capex) in global mining peaked in 2012 and remains nearly 50% below peak levels despite high metals prices.

Metals and Mining

Metals and mining companies are right at the beginning of the industrial supply chain and that sector has been as much a contributor to the supply chain disruptions as it has been impacted.

The Set Up

Pressure has been building in the metals and mining supply chain for close to a decade before the pandemic-driven disruptions hit. Capital expenditure in the mining sector globally had peaked in 2012 and by 2016 was 57% below peak levels in response to low commodity prices. Capital expenditure had recovered in the subsequent years (along with commodity prices), but is still about 47% below peak levels despite metals prices nearly at all-time highs.

Figure 58. Global Mining Capital Expenditure (US$bn)

Capital expenditure had fallen below levels required for maintaining current production levels in 2016-18. In commodities like iron ore and platinum group metals (PGMs), the market (including the mining companies) had made the assessment that demand will imminently go ex-growth and therefore producers were not adding capacity. In metals like steel, aluminum, coal — where China has been the main source of overcapacity — supply side reform had effectively reduced global steel capacity by 10% and coal mining capacity by 5% since 2016.
Decarbonization pressures have also constrained supply.

A tight supply-demand balance already existed before the pandemic.

The other constraint on supply was the shift to environmental, social, and governance (ESG), which gained ground in the later part of the last decade. Decarbonization pressures made investing in new coal and steel capacity unviable in many parts of the world. The Social and Governance risks of operating in certain jurisdictions in developing or frontier markets — where mineral resources are found — meant that investing in metals that were even more desirable in an energy transition world, like copper and cobalt, came with much higher hurdle rates and was thus left to companies who could operate below the radar of western ESG scrutiny.

All this time, demand continued to grow — copper equivalent annual metal demand grew at 2.3% per year during 2012 to 2019. As a result, excess capacity in metals production had all but vanished by 2019 and the seeds were already planted for a supply constraint-driven supercycle.

**Pandemic Impact**

The pandemic highlighted the tight supply demand balance that already existed in the market. The revenue-weighted commodity basket price of the metals and mining sector was down less than 13% from the pre-pandemic levels in early January 2020 to its trough in April 2021 when most of the world went into lockdowns, and was back to pre-pandemic levels by June 2020 itself and kept increasing until the third quarter of 2021.
Metal pricing remained resilient largely due to low inventory

The key driver for the resilience of metal pricing has been low inventory levels (at the lowest levels in a decade in most metals by January 2020 itself). Metals inventories are the critical buffer in any large-scale supply chain disruptions and that buffer did not exist going into the pandemic.

The pandemic did impact metal production due to lock downs etc., but only marginally. The pandemic-driven supply disruptions in metals was less than 2% for the full year of 2020 on our calculations. However demand grew through the year due to the massive credit impulse unleashed by China during March 2021 through October 2021 (China steel demand as an indicator was up 7% year-on-year in 2020 more than offsetting steel demand decline in the rest of the world). Inventories that were low to start with before the pandemic drew down even more.

Strong demand and inadequate supply resulted in price increases

Post pandemic recovery in metals — broadly back to trend levels of demand growth in 2021 — meant a sharp rebound in demand from the third quarter of 2020 onwards. The Chinese credit impulse in 2020 and pent-up demand in the rest of world post pandemic with high levels of disposable income, resulted in very strong demand — the magnitude of which was never going to be met with adequate supply. So the rationing mechanism of the market (i.e., price increases) has come into play.
Metals and Mining Companies as a Recipient of Supply Chain Bottlenecks

Energy supply costs (in terms of cost of power and power rationing in places like China) and higher freight/shipping costs have been the two areas where supply chain constraints have hit the cost of production of the metals and mining companies. It has not really impacted the profitability of the metals and mining companies as these increased energy costs are more than offset by price increases of the metals (and lower production means significantly higher prices for production that is still happening).

Longer-Term Outlook

Metals have very long lead times. A mid-sized copper mine from discovery of the deposit to commercial production takes two decades. Even a fully permitted and funded copper mine takes 4-5 years from start of construction to full ramp up. With near full capacity utilization and very low inventory supply, prices are inelastic in the short term. Moreover most metals and mining companies are on “wait and watch” as to the magnitude of the demand rebound we will see from the market and hence we do not expect to see a rush of new project announcements in the near term.

ESG constraints that have held supply back (at least at the global listed mining companies) are not going away, and if anything have intensified over the last 18 months — whether it be in terms of Scope 1-3 emissions of the metals and increasing scrutiny on traditional/native owner rights. This has meant that the mining companies have been reluctant to launch new projects despite the commodity price signals remaining very conducive to supply increases.
Industrial REITs

Industrial landlords have benefited from an acceleration in supply chain transformation underpinned by growing and faster adoption of e-commerce acceleration, shifts to higher inventory levels (just-in-case replacing just-in-time), and a continued push to locate facilities in and near major population centers enabling quicker and more cost-effective distribution. While supply chain disruption and labor shortages persist, industrial REITs are somewhat insulated as demand outstrips supply and drives outsized rental growth in supply-constrained markets, as well as lower e-commerce costs compared to physical stores. These themes are playing out globally. We view the industrial REITs as well-positioned to capitalize on this period of supply chain disruption.

U.S.

Supply chain and labor market disruptions continue to impact every sector, and real estate is no exception. However, this disruption has accelerated trends that were already underway and proven to be a positive demand driver for the industrial real estate sector. Industrial landlords have benefited from an acceleration of e-commerce demand as pandemic-related restrictions forced many to stay at home. This rise in online ordering, and the speed at which customers demand their goods to be delivered, exposed weakness in tenant supply chains as systems became stressed from stock-out situations and delivery issues. As a result, users from across sectors and industries have taken a deeper look at their supply chains and realized the need for modernization and transformation. A couple of the most meaningful drivers and changes are moves to more inventory (just-in-case replacing just-in-time) and a continued push to locate facilities in and near major population centers, enabling quicker and more cost-effective distribution, both positives for industrial REITs.

We expect inventory build-out will outweigh labor inflation and shortages, as warehousing and last-mile distribution increases.

Tenants are at all different stages of supply chain evolution and transformation and are trying to solve the logistics puzzle in different ways. The need to be close to the consumer to accomplish this — as well as cut transportation expenses which make up ~70% of overall supply chain cost — continues to increase the demand for infill, last-mile facilities. Prolonged shipping delays and port congestion are pushing users to buildout onshore capabilities to bypass global delays, and build out safety stock to avoid stock-outs seen during the pandemic. This has particularly been beneficial in the Southern California market, where rental growth has far outpaced the national average. To combat port congestion, the Ports of Los Angeles and Long Beach and International Longshore and Warehouse Union (ILWU) workers shifted to 24/7 operations to decrease shipping containers sitting idle. While these efforts have helped to decrease congestion, retailers will likely learn their lesson from this episode when analyzing leasing decisions.
Supply in desirable logistic markets remains constrained, which has helped drive rental rate growth. The influx of e-commerce demand and supply chain mitigation has bolstered leasing volumes, as users who have been focused for years on “just-in-time” inventory to help mitigate storage and carry costs are now forced to transition to and embrace “just-in-case” inventory volumes to avoid stock-outs and protect consumer relationships, further leveraging industrial REITs’ ability to drive rental growth.

The industrial REITs have consciously pruned and aligned their portfolios to include higher quality, more desirable product in well-located markets. They have followed the same demographic drivers that are factored into user expansion plans and strong rental rate growth has been a positive result. We expect the REITs to continue to grow through development on land under control in these same markets. There is likely significant value in potential conversion of some of the legacy product in the portfolios to higher and better uses, but being offset by strong demand and rental rate growth from industrial and distribution users.

Supply chain disruption is increasing the cost of construction inputs, most notably steel and timber. As such, the cost for industrial development has increased, pressuring margins. However, rental rate growth is outpacing the increases in costs, helping to stabilize construction yields for industrial REITs. The largest REITs and developers are leveraging longer budgeting and planning models to secure materials ahead of time and also flexing scale and buying power to ensure suppliers steer materials their way.

Supply chain users have struggled with labor, particularly within the cold storage and food production space which has led to decreased volumes and therefore decreased the level of inventory being stored within temperature controlled warehouses. Commentary from industrial REITs also suggest labor shortages are driving wages higher for operators as well as warehouse customers. It is not clear when labor shortages and cost pressures will abate but commentary from industrial management teams suggest a recovery into late 2022 or into 2023.

We forecast these supply chain and labor issues will persist, which should serve as a catalyst for more industrial warehouse leasing. We view the industrial REITs as best positioned to capitalize on this period of supply chain disruption due to increased demand for inventory build-out and adoption of e-commerce.

Europe

In Europe, the largest marginal demand driver is still e-commerce and the need for users to build out logistic capabilities to reduce impact from disruptions and meet fulfill rising online orders. Re-shoring, supply chain decentralization, speed of delivery, demand for space from multiple sectors, rent crossover to retail, and conversion of retail to logistics are also demand drivers. From a labor perspective, third-party logistic (3PL) providers are struggling with staffing, particularly with larger global e-commerce players taking a larger share of the market. Labor wages are also rising as base pay levels increase in order to staff positions, particularly for truck drivers.

Assuming e-commerce penetration rises from 14% to 50% and assuming every $1 billion of sales translates to 2 million square feet of demand, warehouse space would need to increase 93%. While the entire industrial market has enough space to fill this demand, conversion into logistics space typically has longer delivery times due to zoning and municipality constraints, and labor shortages will delay development timelines. Demand for industrial land remains competitive, particularly as other real estate sectors compete for space.
From a labor perspective, **retailers are incentivized to build out supply chain capabilities to avoid rising labor costs**. Wages and rent as a percent of revenue for physical retail is 27% and 7%, respectively, while wages and rent as a percent of revenue for online orders is 15% and 1%, respectively. Warehouse automation initiatives will further cut wage costs, although over a longer period of time. Rising costs from supply chain and labor disruption will also drive more industrial demand in Europe. Shopping center rents and retail warehouse rents are typically at a higher per square foot (PSF) cost to the user than standard industrial warehouse rents.

As such, more European retailers will look to reduce costs while expanding logistic capabilities by increasing standard industrial warehouse exposure.

**Australia**

In Australia, **supply chain pressures are impacting development pipelines for REITs**, most notably residential and commercial developers. However, cost increases have been higher in both the U.S. and China relative to Australia.

For industrial development, feedback from REITs indicates that material costs (steel/concrete) have risen 10%-20% driving a greater than 5% increase in overall costs. The full impact of increased costs is not hitting margins due to rising rental rates helping to offset cost pressures. For residential development, material costs (steel/timer) have risen 5-10%, driving an overall increase in costs of 2%-3%. Similar to industrial developers, residential developers are mitigating the costs of rising input costs by pre-ordering materials and moving to locally sourced inputs wherever possible.

**Logistic costs are also increasing for both commercial and residential developers.** In order to absorb these costs, developers are passing off costs onto customers through increased end-product prices. Where developers are experiencing negative supply chain impacts is on development delivery times. The time cost for developments has increased as development completion timelines have increased by a few weeks following procurement issues.

Labor costs are less of a concern in the Australian real estate space. There has been some upward pressure on the cost of subcontracting, especially for residential, but this impact has been relatively immaterial on the margin.

**Demand remains robust and is driving record development starts in some cases**

Overall, **demand for industrial assets remain robust**. In fact, certain industrial REITs have recorded record development starts in both FY21 and 1Q22 as tenant demand drives development projects.
Helping Clients Adapt to a Changing World
An Interview with Shahmir Khaliq, Global Head, Citi Treasury and Trade Solutions

By providing an integrated suite of innovative and tailored cash management and trade finance services to multinational corporations, financial institutions, and public sector organizations across the globe, Citi Treasury and Trade Solutions (TTS) helps to enable clients' success. The pandemic, the forces of globalization, new and emerging technologies, along with radically changing business models are creating opportunities and challenges alike for TTS clients. Here, Citi's Global Head of TTS, Shahmir Khaliq, explains some of the principal developments in recent years, looks at strategies to help mitigate today's supply chain challenges, outlines the importance of optimized working capital management, and assesses the growing importance of environmental, social, and governance (ESG) issues on global supply chains.

What are the major supply chain trends in recent years?

Over the last three years we have seen a significant shift in client flows and, in response, have delivered the necessary infrastructure to help enable clients to achieve their objectives, such as streamlining their business processes. Quite naturally, against what has at times been a very challenging backdrop, clients have sought to enhance their working capital and liquidity management capabilities. Optimizing the supply chain is a big part of addressing these challenges; Citi TTS has worked more closely than ever with corporations' Treasury and Procurement professionals in recent years, to provide accretive solutions supporting operationally and financially their supply and distribution chains.

One major trend we are seeing is the accelerated adoption of technology, including digitization, data analysis, and tools like application programming interfaces (APIs). This is especially the case in relation to optimizing working capital, which has become a key metric for many investors when analyzing the health of a company. Many of our clients benefited from solutions implemented pre-pandemic which helped to address these needs, using products such as supplier finance, which is an early payment solution supporting suppliers' financing needs and also helps optimize the corporate's own working capital.

With the advancement of data analytic tools, many clients have also benefited from better cash visibility and management through cash forecasting tools, as well as liquidity pooling structures for multi-nationals. Citi offers one of the most comprehensive liquidity management networks in the world, which can give our clients a significant level of support. Our focus this past year has been on providing clients with better data and analytics, real-time liquidity management solutions and dynamic investment opportunities that dramatically move the needle and help enable bottom-line business growth.

How have conditions changed more recently for TTS clients?

TTS processes around $4 trillion of flows each day. That volume gives us powerful insights on trends across industries and regions. Comparing the third quarter of 2021 with 2019, we can see that activity levels across sectors appear to have bounced back to above pre-COVID-19 levels — with technology predictably leading the pack with 33% growth (see charts below).
Most regions have also returned to pre-pandemic levels except for EMEA — with Latin America and Asia seeing the highest growth at 44% and 30%, respectively.

As we all know when looking at flows through a quarterly lens, there was a big dip during the first and second quarter 2020, but since then most regions have recovered (see Figure 64). All regional flows have increased quarter-on-quarter with average growth of 12%. Latin America’s latest quarter-on-quarter growth is a remarkable 50%, while EMEA has begun to rebound strongly with 18% growth in the last quarter.
Similarly, all sectors have enjoyed quarter-on-quarter growth, with natural resources and clean energy transition (NRCET), health care and consumer experiencing the highest growth rates in the last three months.

How are the recent supply chain disruptions being felt by Citi clients?

The supply chain disruptions globally are the byproduct of multiple events including national lockdowns, port congestion, and labor and energy shortages, layered on top of rising geopolitical tensions, and of course, very easy monetary conditions which has helped to fuel demand. As different parts of the world reopen their borders, lift social mobility restrictions, and resume manufacturing operations, we see an imbalance of supply and demand in the market as suppliers and sellers struggle to keep up with the demand from reopened economies.

Our Global Trade group supports clients’ cross-border trade transactions involving the importing and exporting of goods and facilitates the payment process while also helping to mitigate risk on both sides of the transaction. This gives us a close first-hand perspective of the impact of the current challenges.

The supply chain disruptions have caused increases in shipping costs, delayed shipments and resulted in shortages across the supply chain, forcing many of our clients to re-think their inventory management from just-in-time to just-in-case. All of these changes in the supply chain can have implications for clients’ working capital and their cash conversion cycle, whether on the buy or sell side of the procure-to-pay cycle. Depending on where our clients are in the supply chain process, one of them can incur the increased costs as a result of the elongation of the order-to-cash process in the physical supply chain. As a result, we have seen increased uptake of our financing solutions, particularly supply chain finance and receivables finance products. Traditionally, these products have been offered to large counterparties on both sides of the supply chain transaction. Supplier resiliency and stability has become an increasing concern to our clients who are buyers of goods and services. Hence, we have seen an increased demand for our supplier finance product to help ensure a buyer’s entire supplier base has access to liquidity.

Our solutions have helped clients to manage through this disruption and the double-digit growth of our Trade business reflects the appetite from and success we have had supported clients.
How has Citi supported clients during COVID-19 and the current supply chain disruptions?

Some of the bottlenecks in the supply chain mentioned in this Citi GPS report are exacerbated by not having proper physical documents readily available to evidence customs payments and transfer of ownership at port arrival. The pandemic and the current supply chain disruptions are acting as a catalyst to prompt a move from paper to digital for cross-border documentation. Citi is working with industry bodies such as SWIFT and the ICC, as well as governmental agencies, to facilitate this shift. The automation and digitization of trade documents will provide a more efficient flow for our clients and help to reduce costs in the overall supply chain.

On the digitalization front, Citi has continued to push innovation, accelerating investment into digital solutions enhancing the client onboarding and implementation experience, developing new self-service capabilities and leveraging data to benefit clients.

For instance, our new digital onboarding capabilities include expansion of eSignatures into 51 countries with a further 20 planned this year. Digital onboarding has increased over 125% in the last 12 months alone. We now support clients to open digital accounts in 90 countries. Digitalization has been especially important as the pandemic restricted clients’ ability to share physical documents with their banks. To help Citi launched DocuSign for clients to manage their trade transactions. It gave clients a more efficient way of sending documents to Citibank for transaction processing. Electronic signatures are authenticated and securely encrypted, making them legally binding, enforceable, and auditable. DocuSign was made available to clients domiciled in eligible countries under the respective country laws.

Across several markets, Citi eliminated the need to submit physical copies of documents for exporter letters of credit (L/Cs) and offered an electronic direct presentation capability on CitiDirect. This allows clients to upload documents on a highly secure CitiDirect platform, which offers discrepancy management and highly secure communications through a Free Format Message module on CitiDirect.

What are clients’ current priorities when it comes to technology?

We always work to align our investments with clients’ objectives. In recent years, their goals have included the need for greater convenience, improved security and – in particular – more real-time capabilities.

To that end, our recent innovations have included Citi® Payment Insights, which gives clients visibility into the status of their payments. By offering a simple download option for MT103, clients can place a stop/recall with one click and issue debit authority. Clients can now manage their service requests at their own convenience while a CitiDirect® Account Certification tool enables them to download proof of account ownership and balances. Instant help services are available 24/7 via the Citi Knowledge Center, our client service platform, where clients can get answers to service queries, and access useful docs and on-demand training.

In order to help keep clients safe and secure, we have expanded the use of MobilePASS soft tokens to enable more clients to log in to CitiDirect by using a highly secure generation of dynamic passcodes from a mobile device. CitiDirect App users can through this add a level of security and easily log in using biometrics.
Mobile logins via biometric authentication have grown by 232% since April 2020. The functionality is available in 84 countries and 69% of app logins now use biometrics.

Our Citi Payment Outlier Detection solution is an analytics tool that compares payments against a client’s historical payment behavior. Powered by machine learning algorithms that evolve and recalibrate, it helps flag transactions for review. Of course, Citi’s three Cyber Security Fusion Centers in Budapest, Singapore, and New Jersey have continued to provide an always-on intelligence-led approach that unifies efforts to help prevent, detect, respond to, and recover from cyberattacks.

In relation to real-time data, Citi APIs have played a major role in helping clients to implement on-demand business models. Since launch, our suite of CitiConnect APIs has grown to over 89 and we have processed more than 1.6 billion API calls to our systems from clients. Citi APIs are helping clients to directly access products and services, providing a seamless and real-time banking experience. Services provided include self-service reports, real-time foreign exchange (FX) information, and account services such as statements, cut-off times and proof of payment. Transactions include payments, instant payments, request-to-pay, and WorldLink® transfers. Our APIs are facilitating digital transformation. We expect API use to continue to grow and integration with clients and their partners to increase in the coming years.

We also recently enhanced our CitiDirect BE® Cash Concentration solution so that clients can manage their cash concentration structures globally and execute changes in real-time with straight-through processing. Plus, our real-time liquidity sharing solution developed in 2020 enables clients to share liquidity across their company in real time, with a uniform global liquidity solution and integrated strategy. Finally, in Brazil, our multi-bank target balance solution, launched in April 2021, enables us to connect with all banks – local and public, small, and large – to facilitate real-time transfers.

Which Citi supply chain and trade capabilities have been especially pertinent of late?

While the trends on digitization, APIs, liquidity management, and working capital optimization have been top of mind for our clients in recent years, recent supply chain disruptions and continued uncertainty around COVID-19 has underscored the importance of a robust working capital management strategy for clients. As trade has been disrupted by the pandemic and more recent supply chain problems, we have supported clients, both through our solutions and our interactions with multilaterals and other banks.

Citi is the largest provider of supply chain finance in the world, managing over 2,500 buyers globally, transacting in more than 130 currencies with over 225,000 unique suppliers. Citi’s scale means we can combine large and diversified structures while leveraging our risk syndication and distribution capabilities. We have seen the negative impact supply chain disruptions have had on our clients and their suppliers’ working capital. While these disruptions are hopefully short term in nature, our solutions help to both address the immediate challenges and provide for enhanced supply chain performance and management over the longer term.
For instance, a solution we put in place for oil services company Halliburton during the pandemic helped to unlock an estimated $150 million in working capital globally and close the gap on supply chain neutrality; working to align vendor and supplier terms, while supporting suppliers with competitive financing; the program has more than 500 suppliers. Citi delivered for Halliburton in countries such as Oman and Iraq, underscoring the value in times of challenge of our global platform. While the program has addressed the short-term challenges created by the pandemic, Halliburton expects to continue to derive multiple benefits from supporting their supply chain, as well as gaining the ability to see their in-country financial supply chain activities on a single dashboard, which enhances their control.

As well as supply chain finance, Citi has recently launched its Global Dynamic Discounting solution in Europe and the U.S. and is looking to expand it to Latin America and Asia Pacific. This solution provides an automated option for Citi buyer clients to make excess cash available to their mid-to-long tail suppliers for early payment, helping to create vital efficiencies and cost reductions and support smaller suppliers — all critical needs in today’s current environment.

We are constantly looking at clients’ needs and ways to make improvements that can benefit them. To this end, Citi is consolidating its working capital solutions under a single business organization to simplify and streamline our current offering. The objective is to orchestrate all our working capital product programs to better align with client needs. We want to allocate capital to where it adds the most value to clients and supporting their success.

*What role does collaboration play in delivering benefits to clients?*

Throughout the pandemic, leading banks have been a stalwart for businesses — working closely with clients to help support their daily operations and working capital needs and ensure the wheels of global trade continue to turn effectively. Being open to various forms of innovation and collaboration is a key part of this. Citi collaborates with multiple carefully selected third parties to help bring enhancements to clients and drive improvements that can benefit the industry and the global economy.

For instance, Citi and International Finance Corporation (IFC), a member of the World Bank Group, have established an $800 million facility to enable trade finance in emerging markets. This supports trade flows and helps businesses cope with the devastation caused by the pandemic. More generally, Citi continues to take a leadership position in the industry, pushing for innovation and collaboration to support our clients’ needs. To that end, we have extended our relationships with fintechs and various consortium members. Citi is one of six founding members of the Trade Information Network (the “Network”), which is now being piloted and will launch shortly. The Network aims to address the demand for financing earlier in the supply chain by enabling corporates and banks to securely communicate information. Citi is also a co-founder of Komgo, which supports global digital trade flows; this year it reached 168 corporate and 33 bank users. In 2020, we became a member of Contour, a digital network and consortium powered by blockchain technology that aims to improve trade finance flows. Citi has also collaborated with other banks and the Ant Group to launch Trusple, a blockchain platform for trade transactions that targets SMEs and banks. Citi is collaborating with TradeLens, a multifunctional blockchain-based shipping platform. Finally, Citi is making progress on its project with EY and SAS to use artificial intelligence to automate the process of reviewing global trade transactions.
How will the increased importance of sustainability and ESG issues impact how corporates manage their supply chains?

The industry is seeing a big push from many clients to use their supply chains as a tool to help improve the sustainability of their businesses. Corporates that have higher ESG scores tend to have suppliers that are deemed to be better ESG performers (see Figure 66). Corporates may therefore be more likely to coalesce around suppliers that are regarded as more sustainable; they need solutions that enable them to reward such suppliers. Citi is expanding its global supply chain finance capabilities to include new solutions that are designed to help clients meet their sustainability goals, including diversity and inclusion initiatives.

Figure 66. Supplier ESG Score vs Company ESG Score Distribution

Note: Analysis done on MSCI World universe by using Truvalue ESG scores (ranges from 0 to 100) combined with supply chain data from Bloomberg. The green horizontal line in the box plot denotes the median of the score distribution for each ESG score bracket.
Source: Citi Global Data Insights, Truvalue Labs, MSCI, Bloomberg

Citi recently launched its first Sustainability-linked Supply Chain Finance program in Asia Pacific for consumer goods group Henkel, aimed at supporting its ESG agenda, helping to improve the resilience of its supply chain and managing its working capital needs. The program began with suppliers in Australia and will be expanded to include suppliers in additional markets. The program is targeted at existing and new suppliers who demonstrate strong or improving sustainability performance. Qualifying suppliers may access Citi’s supply chain financing at more attractive rates on a tiered basis, with rates improving as a supplier’s sustainability score improves.

Citi has also worked closely with the IFC and McCormick & Company, a global leader in flavor, to provide its suppliers of herbs and spices with financial incentives linked to improvements in measures of social and environmental sustainability. The program has started with suppliers in Indonesia and Vietnam and will soon be launched in other countries.
Standards are critical in the ESG space and Citi has engaged with a third-party provider of business sustainability ratings to help ensure best practice in relation to standards and sustainability performance targets. By collaborating with experts in ESG solutions such as ratings platforms, we are better able to support clients’ journey toward sustainability. Our Sustainability-linked Supply Chain Finance programs incorporate an incentivized pricing model for suppliers as a motivational tool to align with a company’s procurement sustainability goals, including ESG issues based on data and insights provided by the third-party provider.

We also work with many multilateral and government agencies to help clients further their sustainability agenda. For instance, we have arrangements with IFC and UK Export Finance that enable clients to benefit from partial guarantee supply chain finance programs that support green financing. By providing risk mitigation support, such programs help to increase the amount of sustainability funding support available to clients. Of course, Citi is also aligning its internal practices — from lending to the use of paper — with our own sustainability commitments.
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Key Insights regarding the future of Supply Chains

GLOBAL REACH

In an effort to achieve cost efficiency, firms scoured the globe for the cheapest suppliers. The result was often far-flung and sometimes complicated supply chains that spanned national borders. Recent global events have highlighted to firms that far-flung complex supply chains carry unexpected risks. This may motivate firms to simplify their supply chains and bring them closer to home.

SHifting WEALTH

The pandemic created a massive shift in consumption away from services toward manufactured goods, particularly durable goods. This rebalancing flowed directly from the incentives that households and firms have faced through the pandemic. As we recovery from the pandemic, demand for services, including dining, travel, and experiences should rebound.

TECHNOLOGY

The uncertainty of supply chains during the pandemic was a wake-up call to many corporates on the importance of supply chain information. One likely outcome is a further embrace of digitization and electronic tracking of inventories and logistics. This should allow firms to more accurately track and project the granular details of inventory requirements and better manage the accompanying logistics.