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Tracking Supply Chain Congestion & Rail Service Surface Transportation Board Hearing (EP 770)

Airfreight & Surface Transportation

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Supply Chains Remain Imbalanced and Congested

One-way import traffic remains a challenge

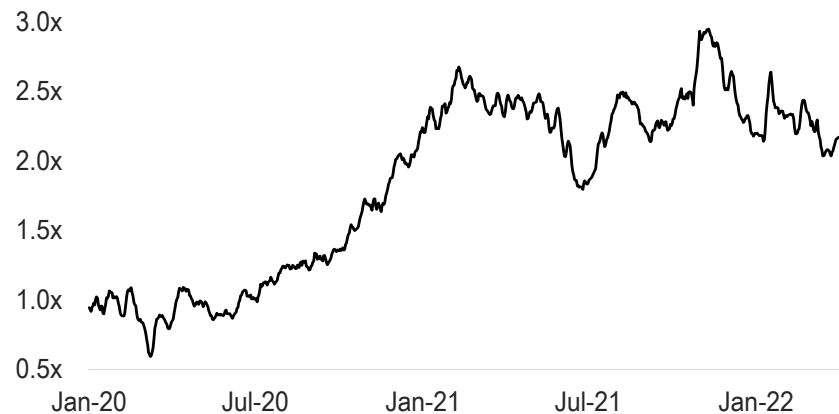
- Ratio of container rates between China and the U.S. West Coast are still skewed to favor Eastbound shipments
- Empty containers are piling up at the port or loaded up quickly, putting additional strain on the existing infrastructure

Port congestion is spreading beyond the West Coast

- Congestion measured in the number of TEUs at port relative to 2019 shows that every major region remains elevated
- Gulf Coast import activity also picking up significantly
- Backlog of ships off L.A. and Long Beach is up 42% from the recent low as shippers try to avoid a potential ILWU disruption
- A surge of imports after China's COVID lockdowns end is another key variable but there are differences versus 2020

West Coast port congestion has stabilized but remains high

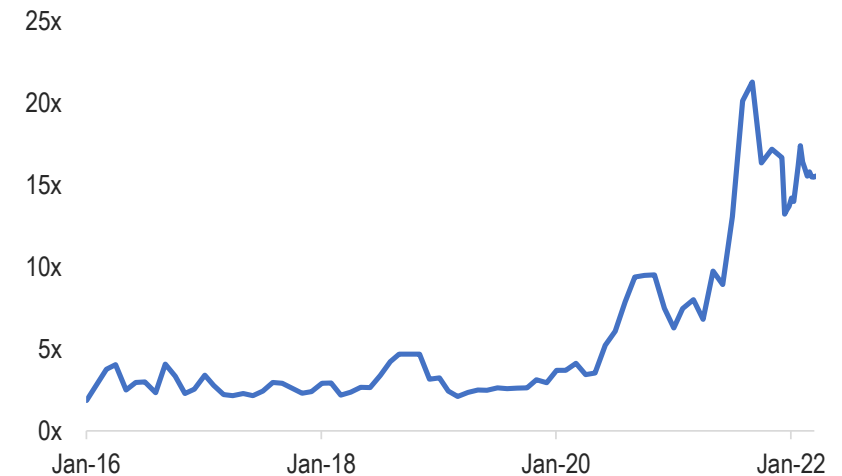
TEUs in port relative to 2019



Source: J.P. Morgan European Transports Team
Note: TEUs are a 7 day MA

Economics incentivize Eastbound sailings from China

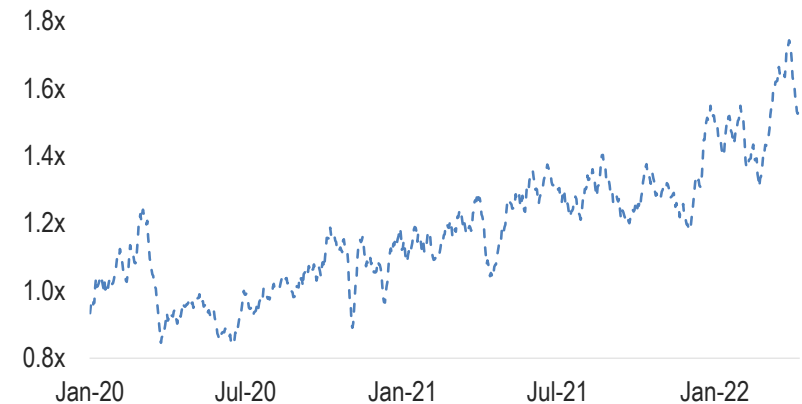
China ↔ West Coast head-haul vs back-haul spot rate ratio



Source: Bloomberg Finance L.P.

East Coast congestion worsened after the West peaked

TEUs in port relative to 2019



Source: J.P. Morgan European Transports Team
Note: TEUs are a 7 day MA

Rail Performance at the West Coast Terminals Is on Our Radar

Container dwell times are on the rise again out West

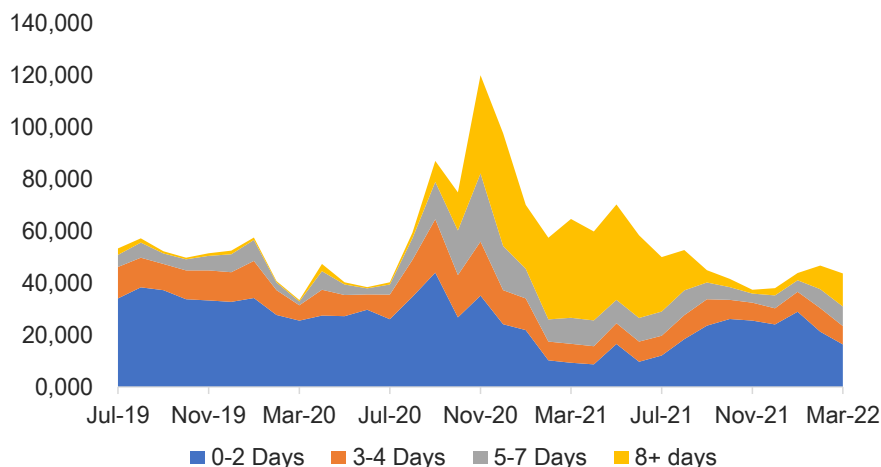
- Dwell times of containers at the West Coast ports have been steadily creeping up after a significant improvement in 4Q21
- Longer dwelling boxes are now a higher percentage of the overall mix and bringing up the average dwell time

Rail fluidity has improved but is starting to slip

- Railroads have driven most of the improvement at the Port of L.A. since May 2021 peak after Western rail service pause
- There are signs of deteriorating rail fluidity since March 2022 at the Port of Long Beach and L.A. based on dwell times
- Truck turn times out of the West Coast ports worsened after rails improved in 2021 but have held in to start the year

Rail-served containers have shown signs of slipping in 1Q22

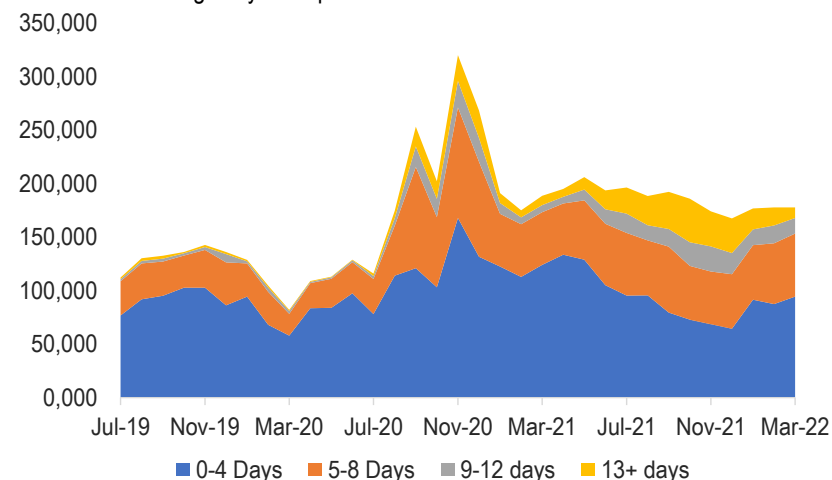
Containers discharged by rail per month



Source: Wabtec Port Optimizer, Port of Los Angeles
Note: Average time container spent on ground after vessel discharge and prior to outgate

Local truck service is picking up speed to start 2022

Containers discharged by truck per month

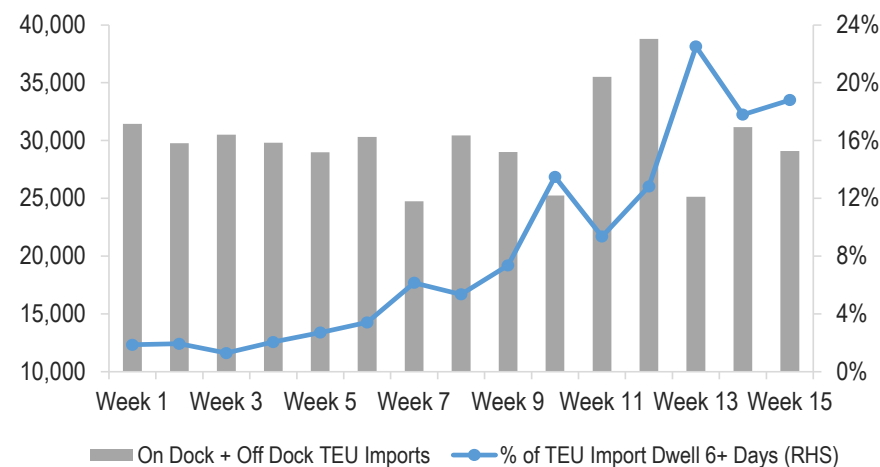


Source: Wabtec Port Optimizer, Port of Los Angeles
Note: Average time container spent on ground after vessel discharge and prior to outgate

Rail import TEUs at LB are flat but dwell times are up

Containers

% Of On-Dock IPI Dwelling 6+ days



Source: Port of Long Beach

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Inland Intermodal Terminal Fluidity Recovered from a Tough 2021

Inland intermodal fluidity was a challenge last year

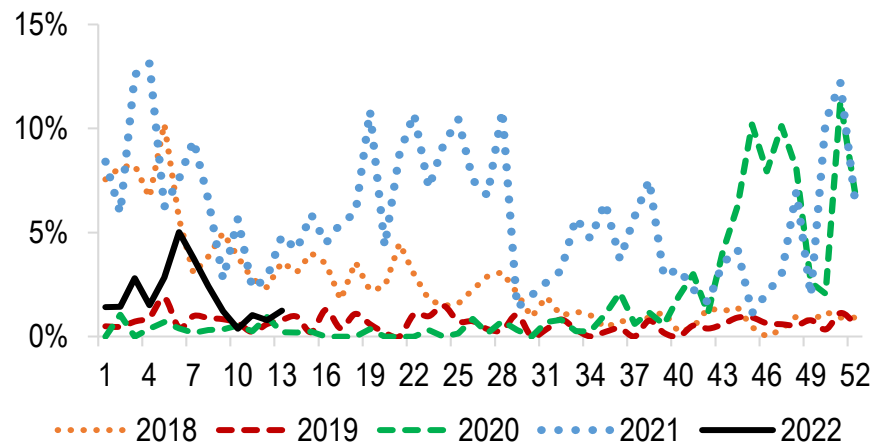
- Multiple instances of gate and terminal closures started in late 2020 as intermodal volumes surged in a shift to goods spending
- Volumes remained elevated through 1H21 and significant weather issues did not help with network fluidity
- Strain on the system was evident in a number of metrics, most notably the percent of inbound tenders rejected

Key inland hubs appear to be fluid, but volume is down

- Surge fees were implemented earlier and at higher levels on certain shipments to protect overall network capacity
- Spread between import and export container rates facilitates more transloading and fewer IPI shipments
- Inventory levels are likely part of the drag on activity

Intermodal Inbound Tender Rejection Index - Chicago

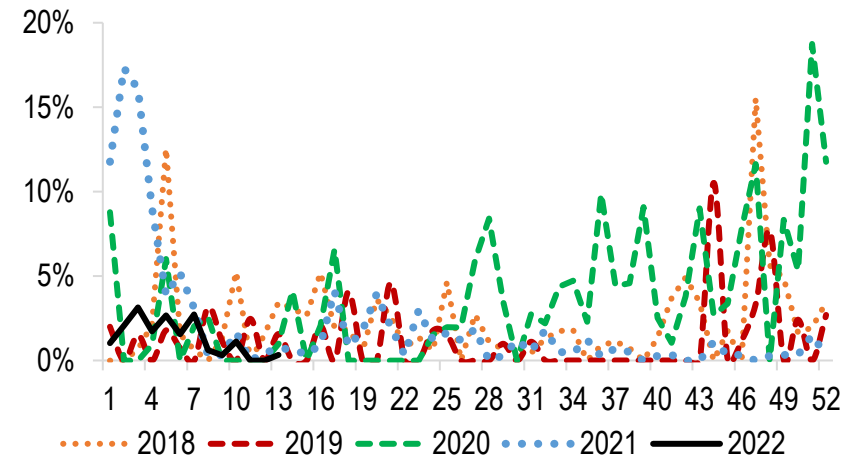
% of tenders rejected



Source: SONAR

Intermodal Inbound Tender Rejection Index - Memphis

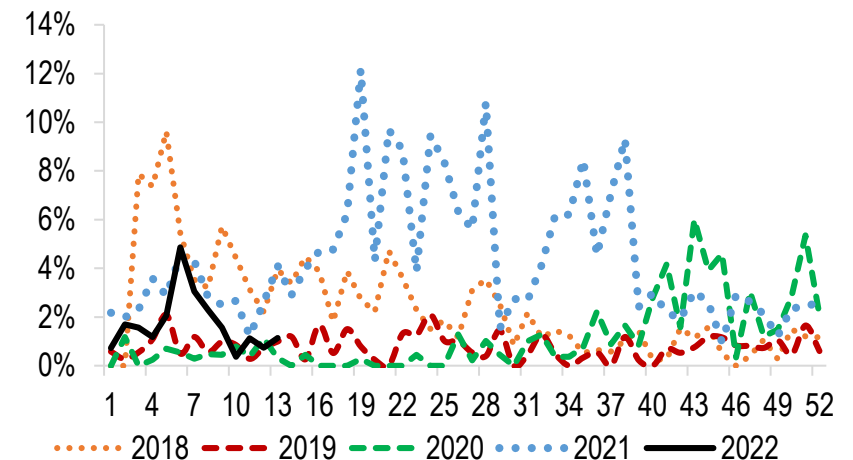
% of tenders rejected



Source: SONAR

Intermodal Inbound Tender Rejection Index - Joliet

% of tenders rejected



Source: SONAR

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Chassis Pools at the West Coast Port Complex Showing Strain

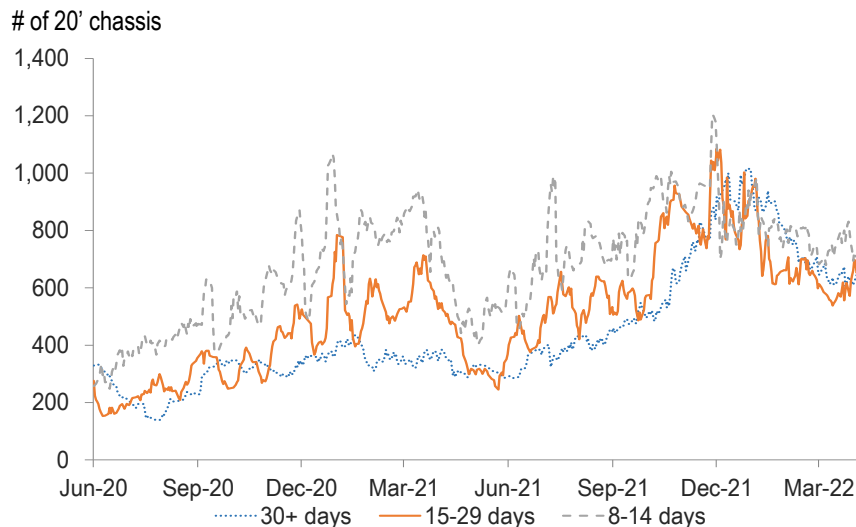
Shared chassis pool running near max utilization

- Chassis are a key congestion indicator as the physical link between port terminals and downstream supply chains
- Utilization in the West Coast Pool of Pools is running near all-time highs, primarily in the 40/45' equipment
- Chassis dwell in the terminals has stabilized but remains well above the 2021 average and initial March 2021 surge

Slow turn times are limiting effective capacity

- Street turns of chassis outside the terminals have stabilized, but 45%+ are running with turns over seven days
- One additional day of street dwell in the chassis pool requires 6% more units to maintain consistent throughput

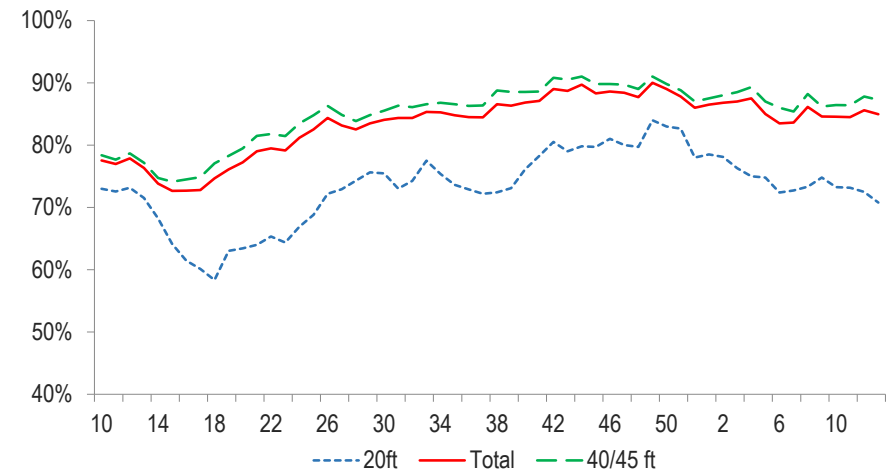
Average dwell time of 20' chassis increasing at LA/LB



Source: Pool of Pools

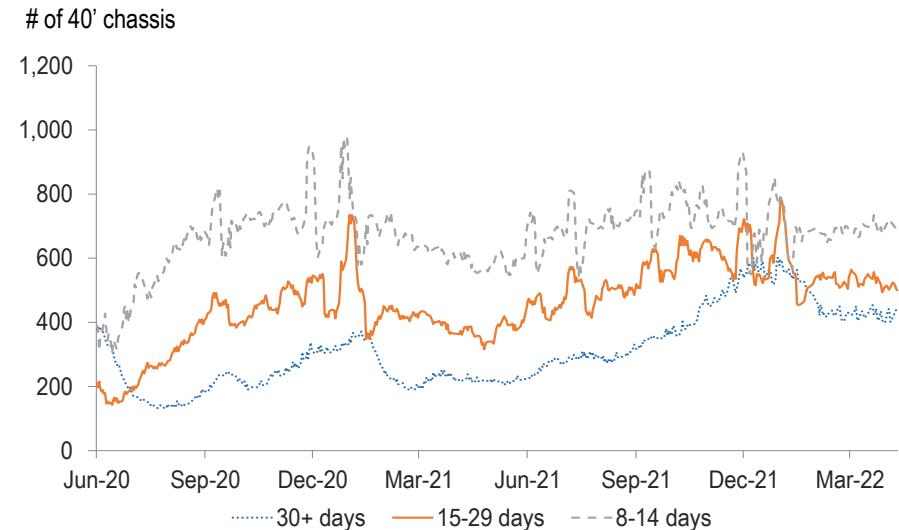
Pool of Pool chassis utilization is still elevated

% utilized by week in 2021 - 2022



Source: Pool of Pools

Near record number of 40' chassis dwelling > 30 days



Source: Pool of Pools

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Downstream Congestion Is Hard to Track, Should See Some Relief

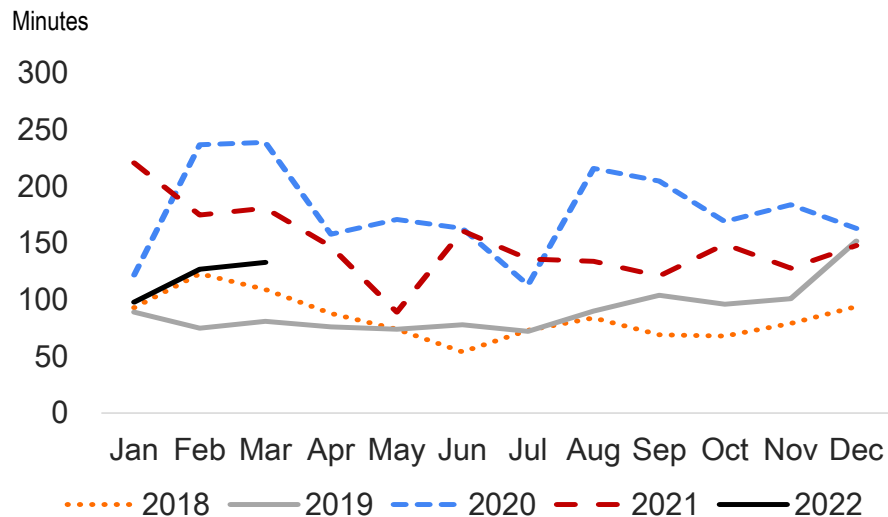
Customer unloading times an often-cited bottleneck

- Chassis street turns are the closest metric we've found for customer unloading times blamed for slower supply chains
- Warehouse turn times should improve with better drayage availability, ending Omicron wave, and higher inventories

Urgency to move freight has shown signs of slowing

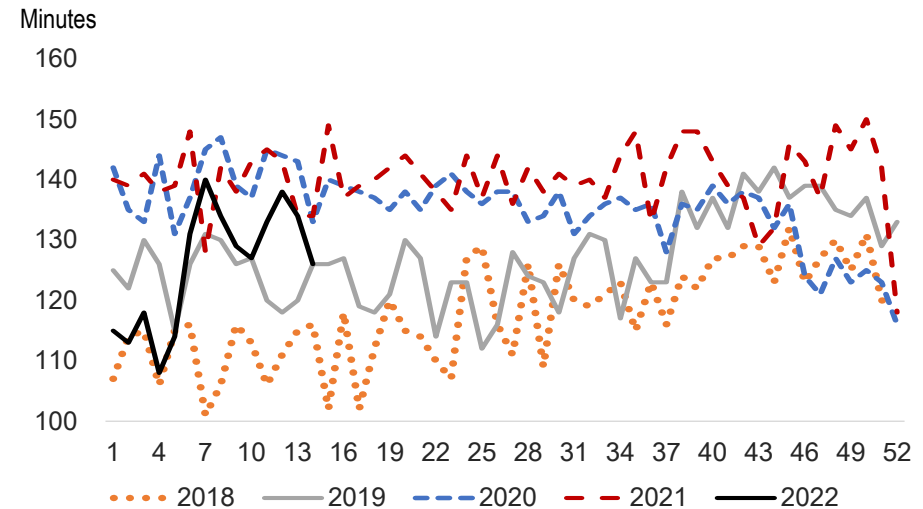
- Fuel price spike has changed some shipper behavior, triggering a focus on improving trailer utilization which requires fewer trucks and will also help warehouse fluidity
- Rates on key truckload lanes from L.A. to major inland warehouses and consumption centers continue plummeting
- Activity at non-West Coast ports is also picking up

Stockton, CA rail ramp dwell times have moderated



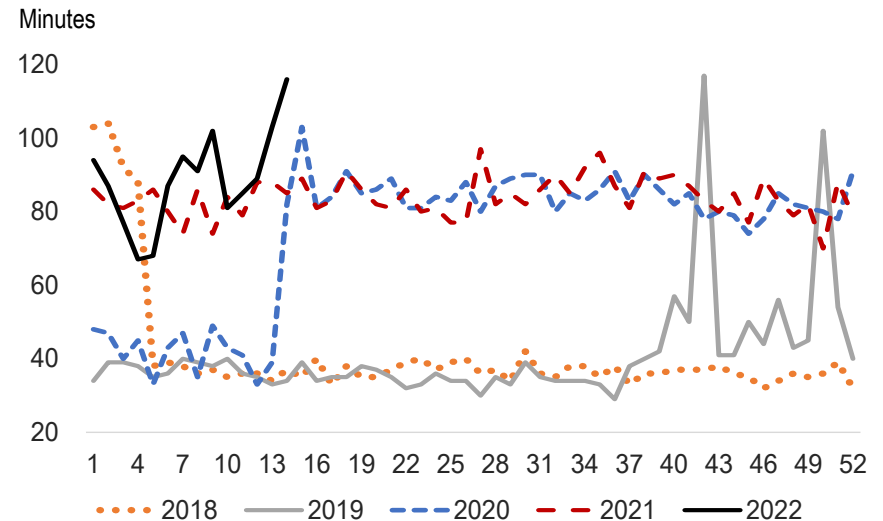
Source: SONAR

Memphis truckload wait times down from 2021 peak



Source: SONAR

Port of Savannah wait times are elevated



Source: SONAR

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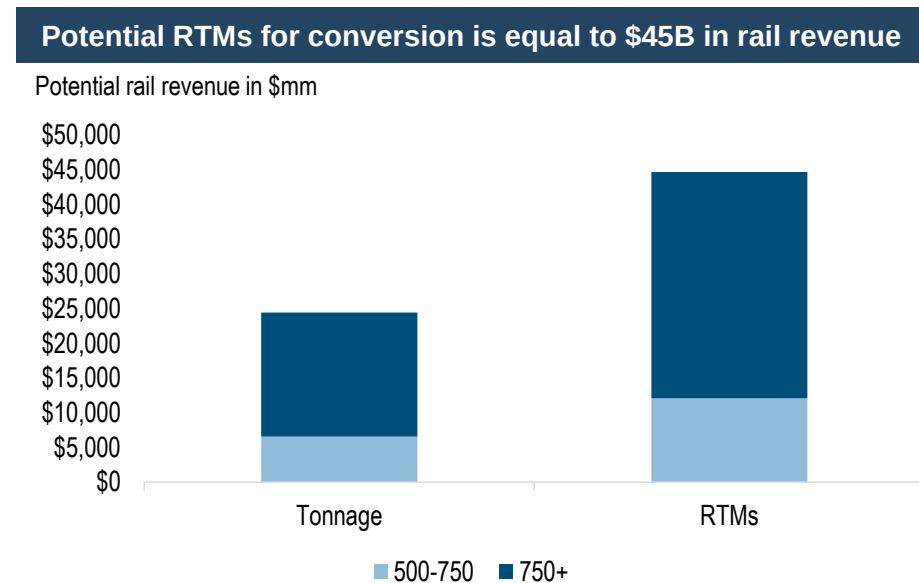
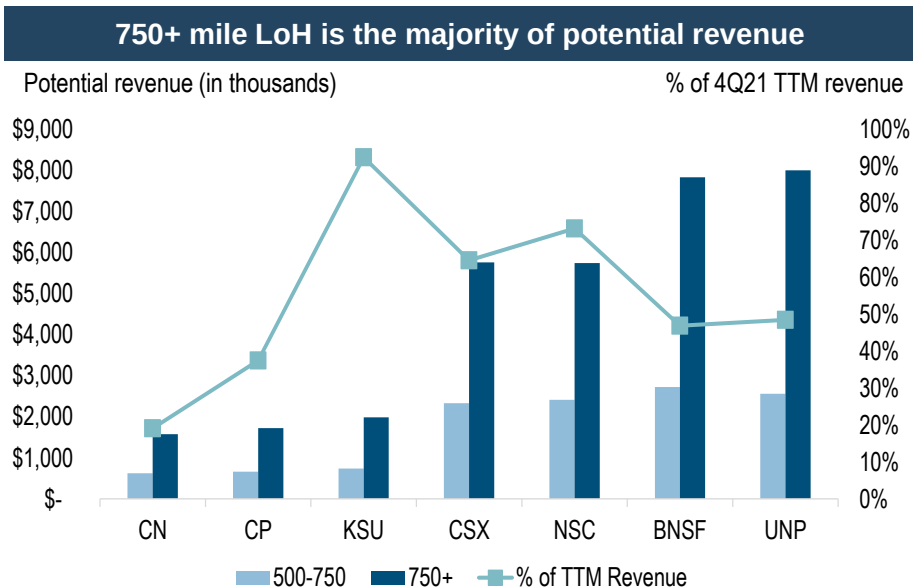
Why Wall Street Cares About Rail Service Metrics

Rail service is one of the key engines for earnings growth

- Lack of network fluidity impacts volumes and efficiency → affects earnings outlook and equity values
- STB inquiries could lead to more data disclosures, hearings and/or regulations
- Demurrage typically increases with network congestion but is a non-core earnings stream

Truckload conversion opportunities won't work with inconsistent rail service

- Investors increasingly expect railroads to generate earnings by utilizing volume growth
- Factors favoring more rail shipments include ESG, volatile truck rate cycles, and higher final mile costs
- The addressable market isn't the whole \$800B freight and logistics spend but it's still massive
- Durable truckload conversion requires investment, partnership and consistent rail service
- PSR should generate more mixed traffic trains to help with recoverability options



What Wall Street Looks For in Rail Service Metrics

Dashboard of metrics presents a multi-layer view of each network

- Combination of speed and cars online provide a snapshot of overall network throughput
- Terminal dwell trends provide another take on fluidity with a seasonal context
- Asset utilization and resource availability is increasingly important in the PSR world

Tell-tale signs of a potential service problem on the horizon

- Slower average train speed and rising cars online is the primary signal of a network potentially under stress
- Deteriorating terminal dwell stats and momentum can confirm and help focus on fluidity issues
- Utilization of cars, locomotives and crews are helpful compared to historical trends but not other rails

J.P. Morgan railroad operating dashboard from our *Weekly Fast Track*

Volume				Terminal Dwell Status			Average Dwell Trend		
	QTD	Momentum	Comps	Positive	Stable	Negative	WoW	Δ Seasonality	Momentum
KCS	1.4%			10%	70%	20%	1.4%	3bps	
BNSF	-6.4%			30%	50%	20%	-2.3%	-129bps	
UP	-0.3%			0%	50%	50%	-2.6%	-152bps	
CSX	1.0%			50%	10%	40%	-1.3%	-74bps	
NS	-2.5%			10%	50%	40%	-1.5%	-128bps	
CP	-5.9%			0%	60%	40%	-1.6%	-234bps	
CN	0.8%			40%	50%	10%	-1.5%	-242bps	

	Network Fluidity			Asset Utilization - Idled Cars				Resource Availability		
	Trend	Speed	Cars Online	Loaded		Empty		Trains Held For →	Power	Crew
KCS	↓			1.6%		1.8%		11.0	0.0	1.0
BNSF	↓			2.9%		3.2%		179.1	31.9	53.1
UP	↓			1.4%		0.9%		175.0	50.0	51.0
CSX	↑			1.4%		1.5%		10.1	0.0	9.9
NS	↑			3.2%		0.9%		90.0	20.0	21.0
CP	↑			1.3%		1.3%		9.0	2.0	0.0
CN	↑			0.3%		0.3%		7.7	0.0	3.6

Source: AAR, Company reports, J.P. Morgan estimates.

Chicago Still a Potential Canary in the Coal Mine

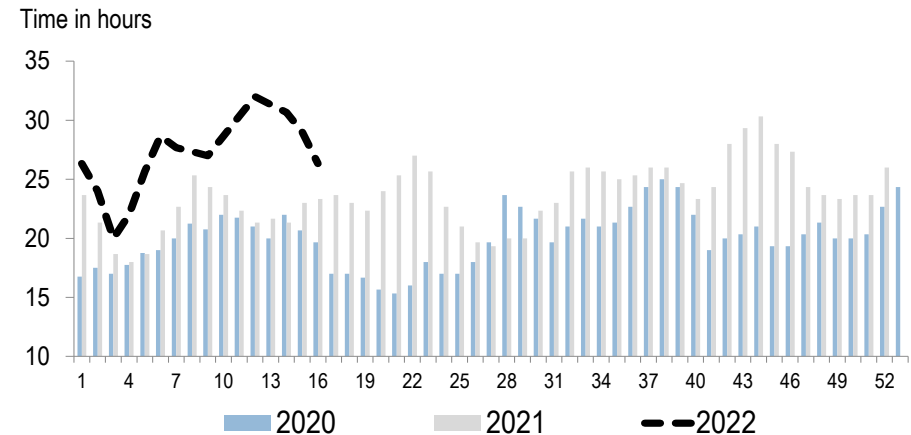
Chicago provides a good pulse on the network

- Multiple metrics for terminal dwell, inventories and activity provide a detailed view on a key hub
- Transit times and interchange events usually provide a good snapshot of the overall rail network health

Weather and COVID have been recent stress tests

- Deluge of inbound volume during the shift to spending on goods has kept upward pressure on transit times
- Transit times steadily increasing throughout 2022 while the number of cars processed is down slightly vs. 2021

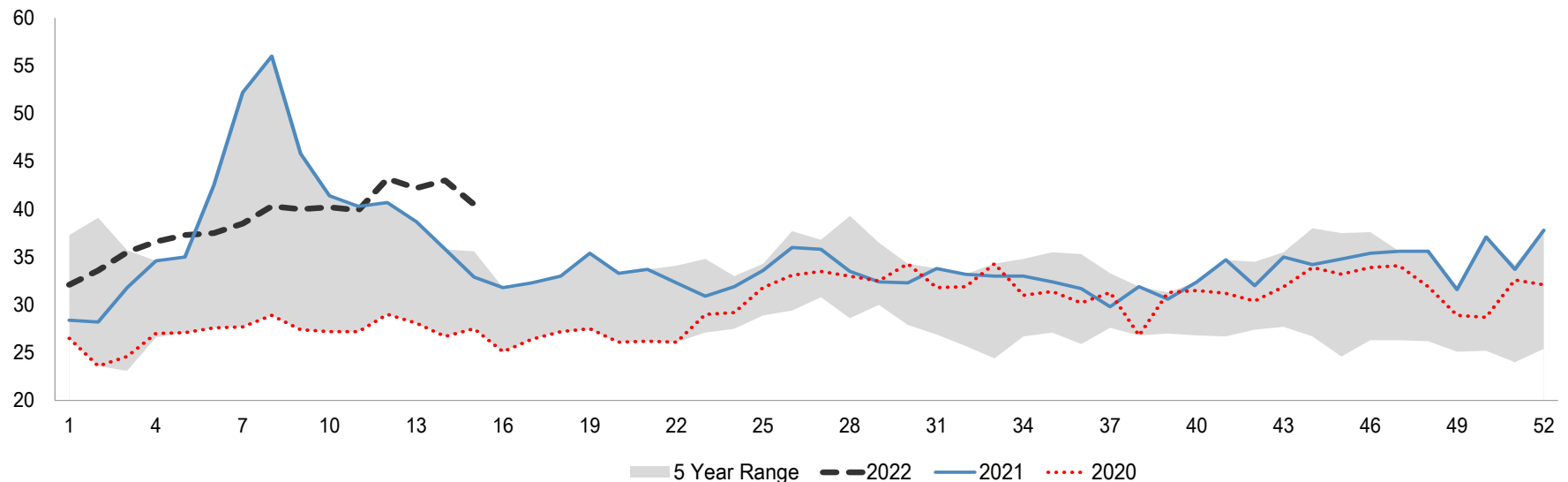
UP's Proviso has shown higher dwell times in 2022



Source: Company reports, STB.

Average freight car transit time has crept higher for shipments moving across Chicago

Average transit time in hours, seven-day average

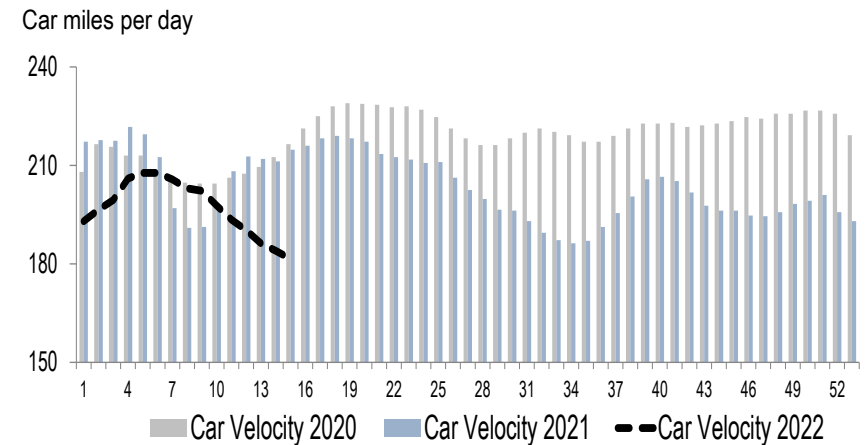


Terminal Dwell and Car Velocity Helps Focus on Potential Issues

Asset turns are critical to rail and shipper success

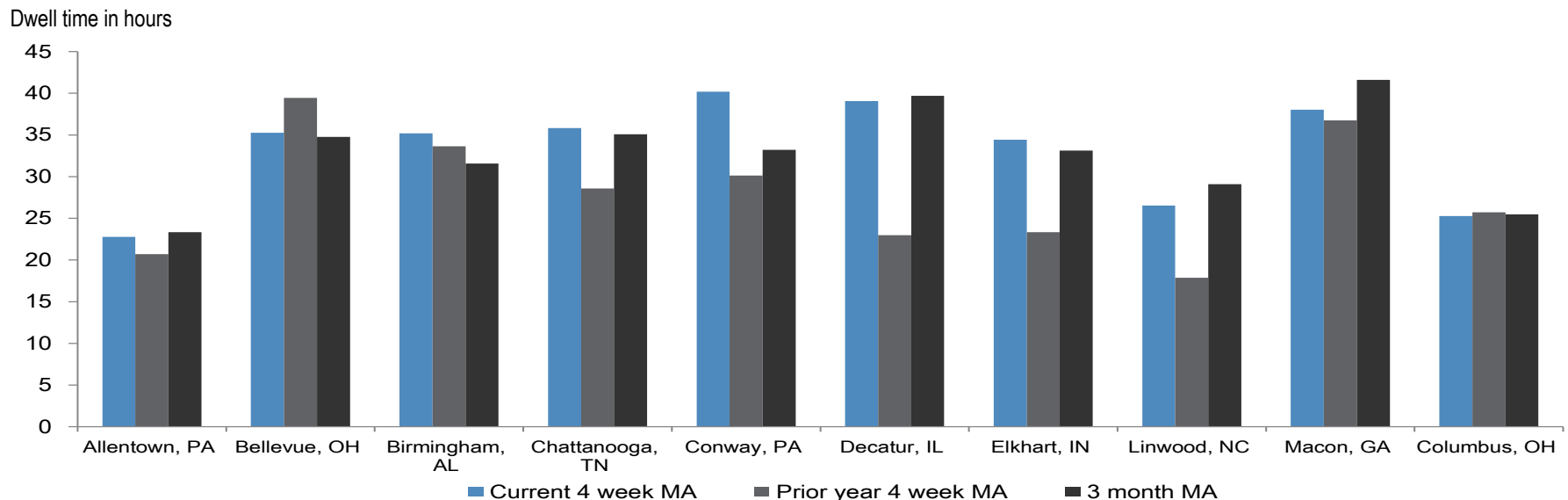
- Falling average train speed rising cars online is the first sign to take a closer look at other operating metrics
- Dwell times can be choppy WoW but looking at the trends YoY and compared to 3M MA controls for seasonality and helps isolate potential issues or improvements
- PSR principles generally focused on asset utilization at the car level but not all railroads disclose car miles per day
- Variable or inconsistent rail service makes truckload conversion more challenging at large scale

UP's car velocity is an indicator of network performance



Source: Company reports

Norfolk has experienced a steady extension of dwell times at several terminals



Source: Company reports, STB

Intermodal Car Fluidity Has Not Recovered from 2020

Supply chains weren't ready for the consumer surge

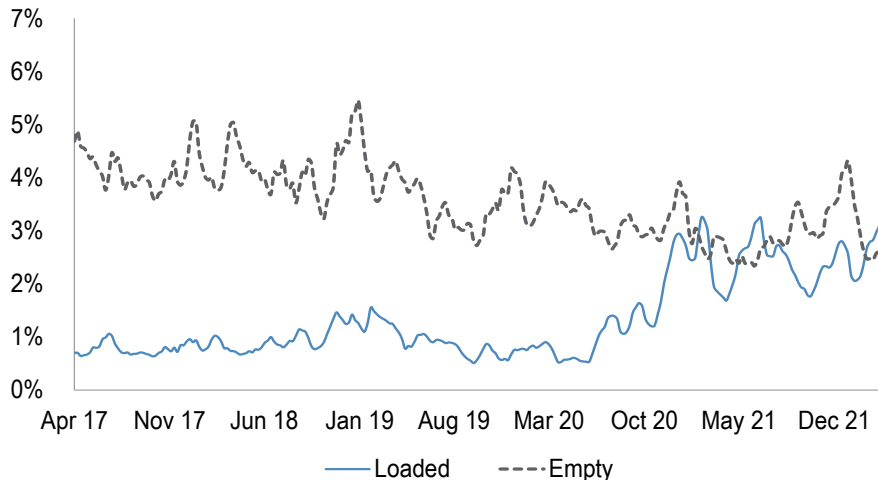
- A massive jump in spending on goods caught the freight industry by surprise, which has played catch up ever since
- Intermodal car delays can be difficult to offset especially when labor is tight at warehouses, ports and shipper locations

Percentage of slow-moving containers is a key metric

- Asset turns at the car level is the most relevant for intermodal given the service sensitive, truck competitive nature
- Changing proportion of idled but loaded containers is a useful leading indicator for intermodal service issues or improvements
- Most networks were gaining ground or holding steady in a weaker 2019 but have not recovered from the 2020 surge

BNSF experienced the largest increase in slower containers

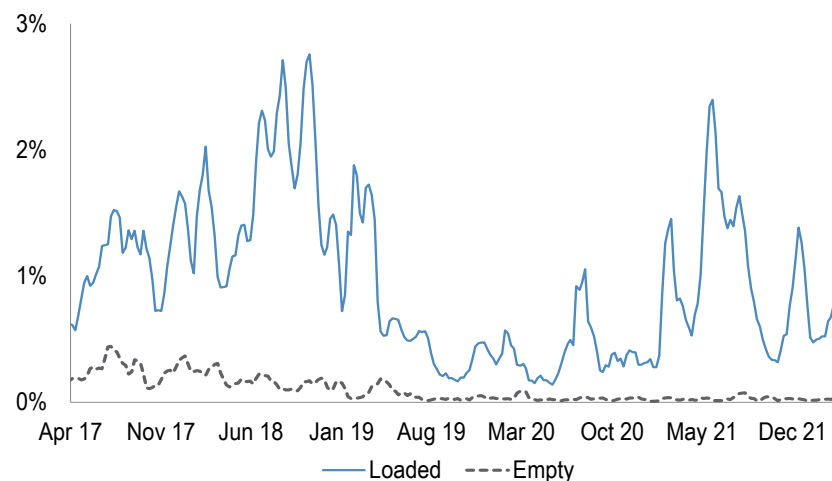
% of Intermodal Loaded and Empty Cars Idled 48 hours+ on the Network



Source: STB, Company reports, J.P. Morgan estimates

UP's network was impacted by West Coast congestion

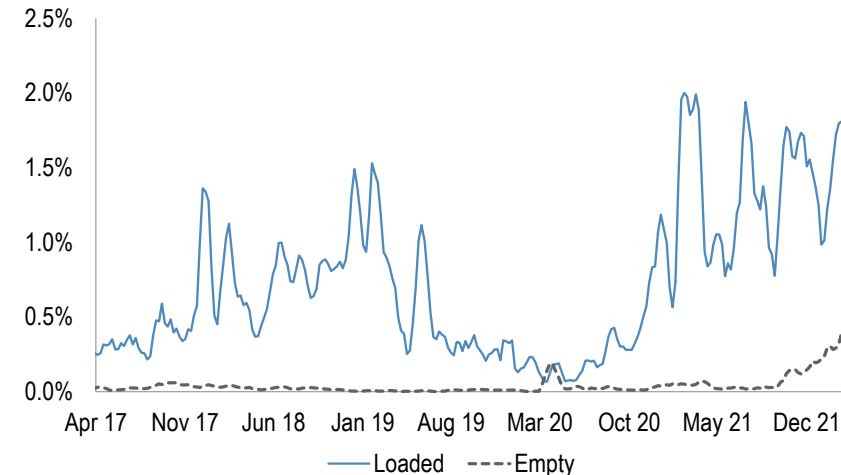
% of Intermodal Loaded and Empty Cars Idled 48 hours+ on the Network



Source: STB, Company reports, J.P. Morgan estimates

NS intermodal fluidity has steadily decelerated

% of Intermodal Loaded and Empty Cars Idled 48 hours+ on the Network



Source: STB, Company reports, J.P. Morgan estimates

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Trains Held Metrics Provide a Glimpse into Railroad Resources

Weekly update helps diagnose conditions in the field

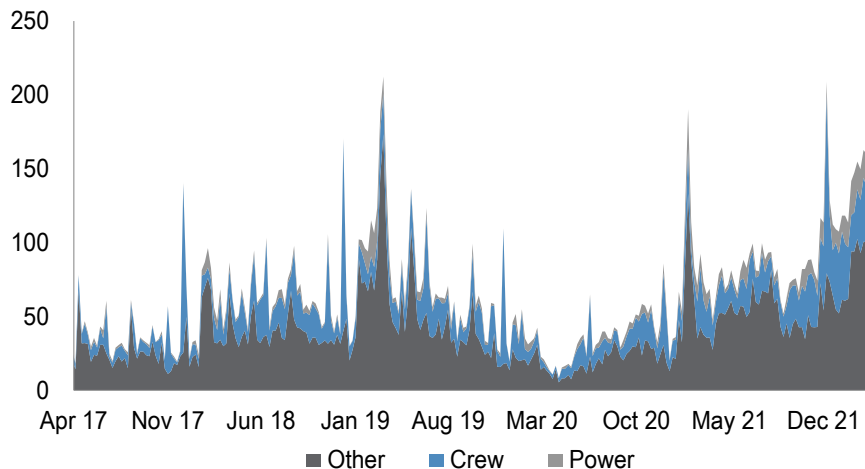
- Railroads disclose the average number of trains held by commodity type and cause
- The metric provides the greatest utility when comparing across the same network to control for size and reporting classifications

Trends have foreshadowed “resets” and shortages

- Weather events, derailments and other factors can create a short term spike in trains held
- Sustained moves typically correlated with specific commodity service issues or improvements in 2021
- Coal also impacted in a strong market for export demand
- Trends in labor availability have been more pronounced since the start of the pandemic and are now a key bottleneck

BNSF total trains held are approaching a record level

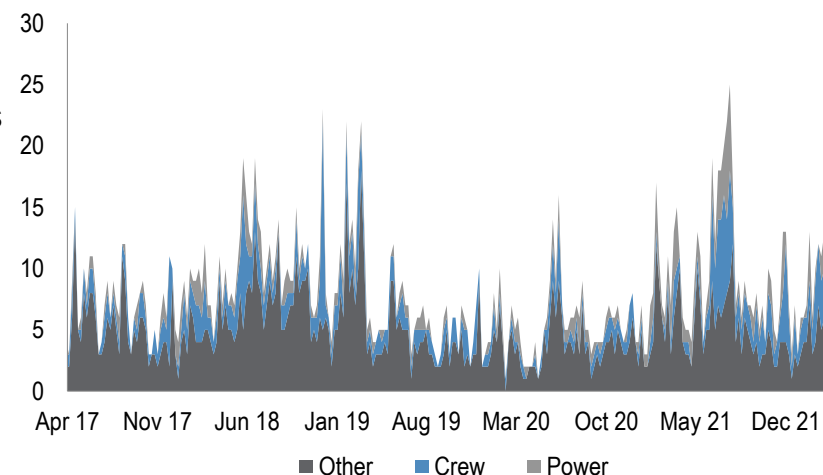
Weekly Average Number of Trains Held Per Day by Cause



Source: STB, Company reports, J.P. Morgan estimates

UP's trains held coincided with 2021 intermodal reset

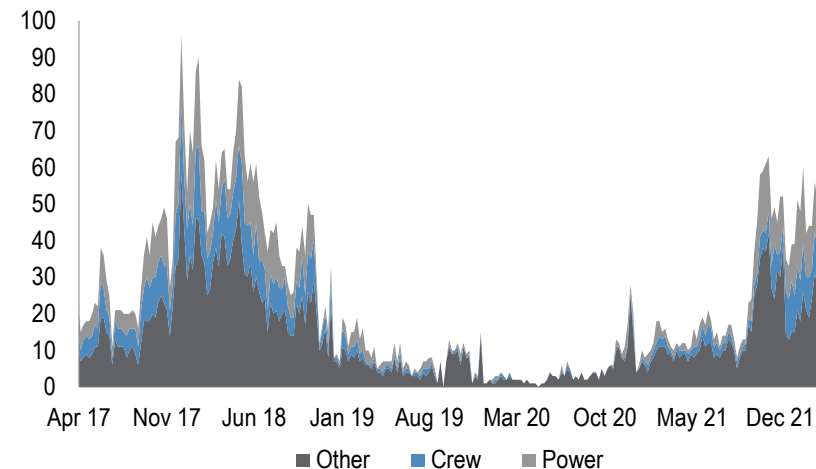
Weekly Average Number of Intermodal Trains Held Per Day by Cause



Source: STB, Company reports, J.P. Morgan estimates

NS manifest network showing strain similar to 2018

Weekly Average Number of Manifest Trains Held Per Day by Cause

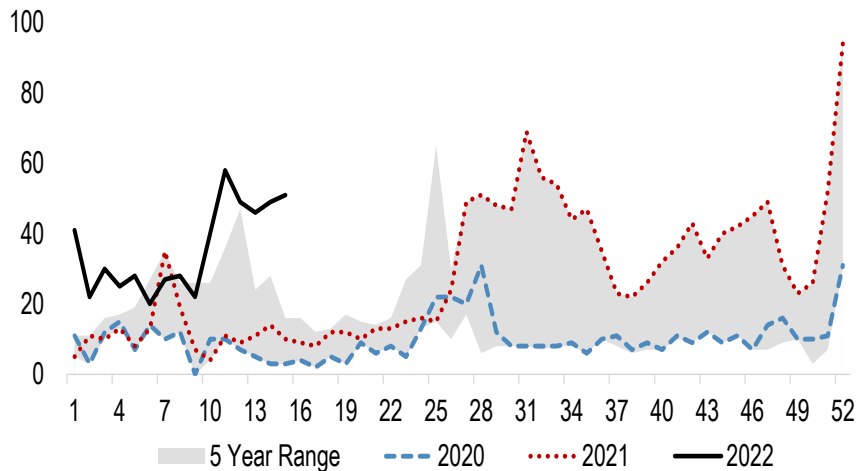


Source: STB, Company reports, J.P. Morgan estimates

Rail Crew Availability Is a Key Bottleneck

UP crew delays have mirrored operational challenges

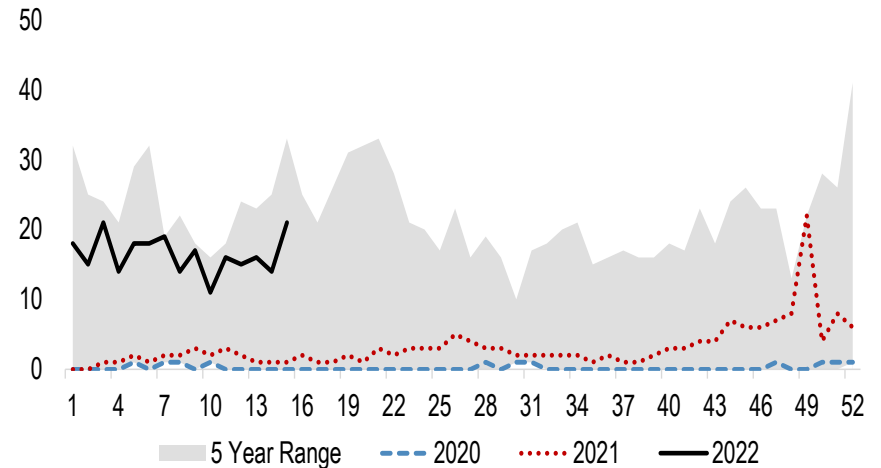
Weekly Number of Trains Holding Per Day Caused by Crew



Source: Company reports, J.P. Morgan estimates

NS crew delays are near the high end of the 5-year range

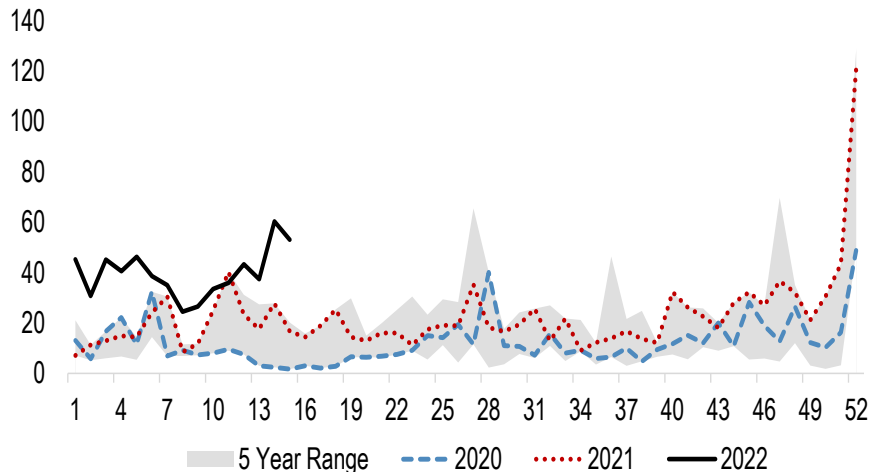
Weekly Number of Trains Holding Per Day Caused by Crew



Source: Company reports, J.P. Morgan estimates

BN yet to recover crew readiness following year end spike

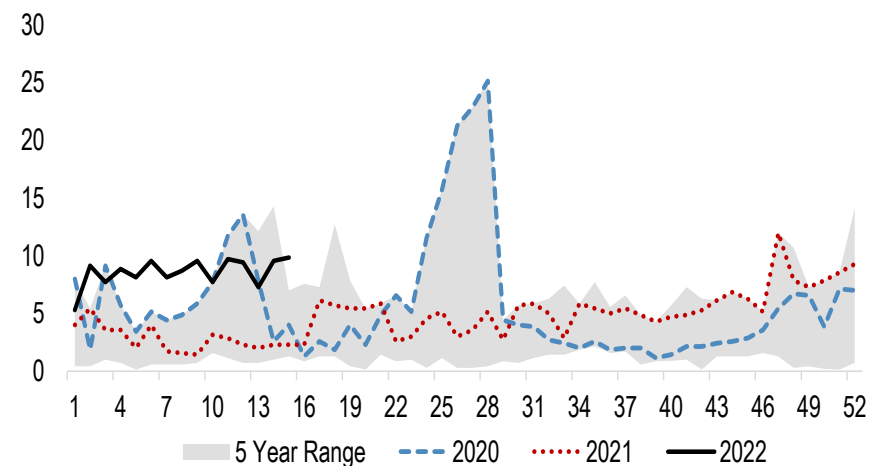
Weekly Number of Trains Holding Per Day Caused by Crew



Source: Company reports, J.P. Morgan estimates

CSX crew availability has held steady to start 2022

Weekly Number of Trains Holding Per Day Caused by Crew



Source: Company reports, J.P. Morgan estimates

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Increasing Rail Headcount Is Now a Good Thing

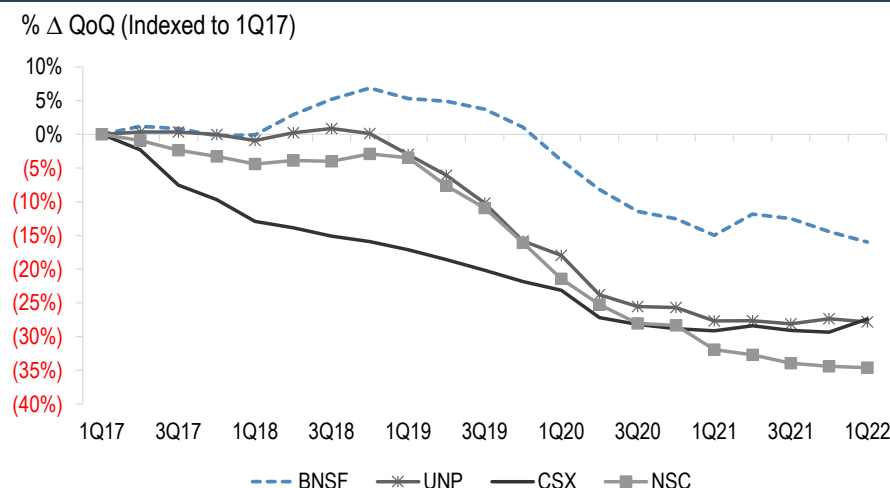
Rail labor productivity is closely watched

- Lower headcount almost always viewed as better, productivity is closely followed and benchmarked
- We took the view that more headcount was a good thing in 3Q21 in part because of vaccine mandate uncertainty

T&E headcount is a resource with a long lead time

- Getting the right amount of people in the right place for uncertain demand and big swings has been challenging
- Labor market is tight and COVID flare-ups make it tighter
- Railroads appear to have an “easier” time managing staffing levels down through furloughs and attrition

U.S. Class I headcount has dropped substantially



Source: Company reports, J.P. Morgan estimates.

J.P. Morgan Class I labor productivity dashboard tracks headcount reported to the STB by employee classification

	Headcount and Volume, MoM % Δ			Labor Category Productivity per Carload ² , MoM % Δ					JPMe Modeling Trends, QTD			
	Overall	T&E Labor	Volume ¹	Total Labor	Other T&E	T&E	Exec & Admin	Maintenance	Average Comp	Headcount vs JPMe	EPS Impact	
Industry	+0.7%	+1.3%	+2.6%	+1.7%	+3.1%	+1.1%	+2.9%	+1.7%			in \$	as a %
BNSF	+0.7%	+1.1%	+2.8%	+0.5%	+2.4%	+0.2%	+1.3%	+0.3%				
UNP	+0.1%	+0.4%	+1.3%	+3.7%	+3.2%	+3.4%	+4.9%	+3.7%	-0bps	+13bps	-\$0.00	-0.1%
CSX	+0.6%	+1.6%	+5.0%	-3.3%	-2.2%	-4.2%	-1.7%	-3.1%	-3bps	+53bps	-\$0.00	-0.3%
NSC	+1.5%	+3.1%	+3.2%	+1.4%	+3.8%	-0.2%	+3.4%	+2.2%	-1bps	+63bps	-\$0.01	-0.4%
*KSU	+0.1%	+1.0%	+0.8%	+1.6%	+1.7%	+0.7%	+2.0%	+2.8%				
*CN	+1.1%	+1.4%	+1.7%	+0.0%	+2.6%	-0.2%	+1.1%	-0.4%				
*CP	+1.4%	+0.8%	-1.1%	-0.8%	+5.7%	-0.1%	+1.5%	-3.0%				

Notes: * Data is U.S. based operations only. ¹MoM volumes are based on a daily carload basis. ²All labor category productivity metrics are based on a 3M MA volume basis per carload

Source: Company reports, J.P. Morgan estimates.

Disclosures

Companies Discussed in This Report (all prices in this report as of market close on 22 April 2022)

CSX(CSX/\$34.52/N), Canadian National Railway(CNR.TO/C\$158.21/N), Canadian Pacific Railway(CP.TO/C\$95.47/OW), Norfolk Southern(NSC/\$258.59/OW), Union Pacific(UNP/\$234.30/OW)

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	Overweight (buy)	Neutral (hold)	Underweight (sell)
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IB clients**	52%	47%	36%
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