PGIM FIXED INCOME

INFLATION

SUPPLY CHAIN STRAIN IN MANUFACTURING

Fixing Inflation with Moderation

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EXECUTIVE SUMMARY

- One of the most salient economic consequences of the COVID-19 pandemic has been the sharp disruption of global supply chains. The simultaneous emergence of large demand boosts and supply shortages led to sharp price increases.
- The evolution of these disruptions will have significant market-moving implications as it impacts the inflation outlook and ultimately the response of government officials. These crucial inputs will shape our views on interest rates and spread products in 2022 and beyond.
- In the first paper in our supply chain series, we assess the root causes of shortages in the manufacturing sector by estimating the extent to which they were supply- or demand-driven. We show this using two different statistical approaches: principal component and econometric analyses.
- Our results confirm that both negative supply and demand shocks played a role at the beginning of the pandemic. But strong demand has subsequently become a big contributor to tighter goods markets as lockdowns gave way to economic reopening that was supercharged by fiscal and monetary stimulus.
- Going forward, the role of the demand side makes these shortages more fixable as reduced policy stimulus lower demand pressures, while a phasing out of restrictions should unclog supply. More positive developments on the virus front should also help accelerate the return of consumption patterns to services from durable goods, alleviating the pressure on supply bottlenecks. Overall, this means goods price inflation should ease in 2022.

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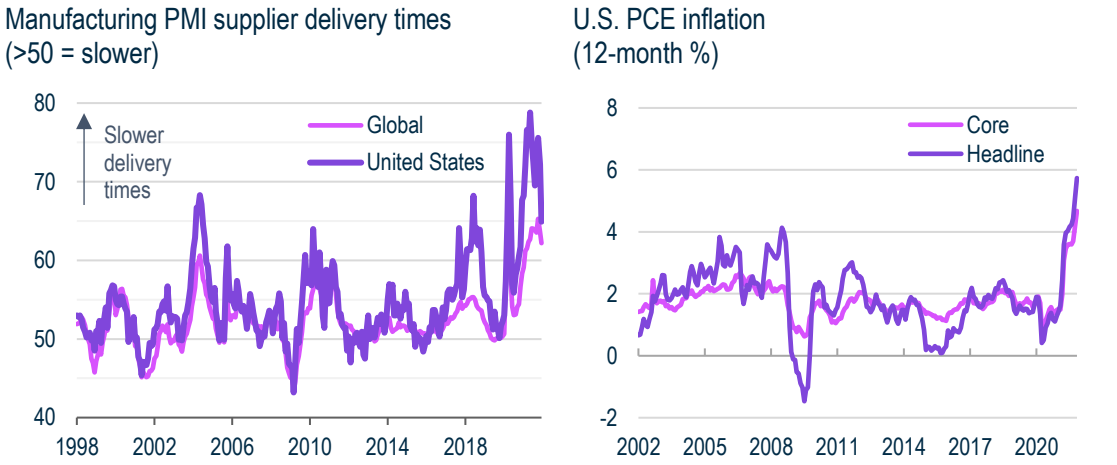
AMPLE STRESS IN GLOBAL MANUFACTURING AND LOGISTICS

By now, everyone has seen empty store shelves, out-of-stock messages online, and footage of flotillas of cargo ships waiting to unload. These elements suggest a scenario of deficient and misallocated supply where prices should rise, all else being equal.

Economic data and surveys clearly support this picture. Figure 1 shows that supplier delivery times have slowed sharply and consistently across the world, especially in the U.S., causing sharp increases in headline and core inflation.

Figure 1: Supply chain disruptions have led to historically slow supplier delivery times and higher inflation



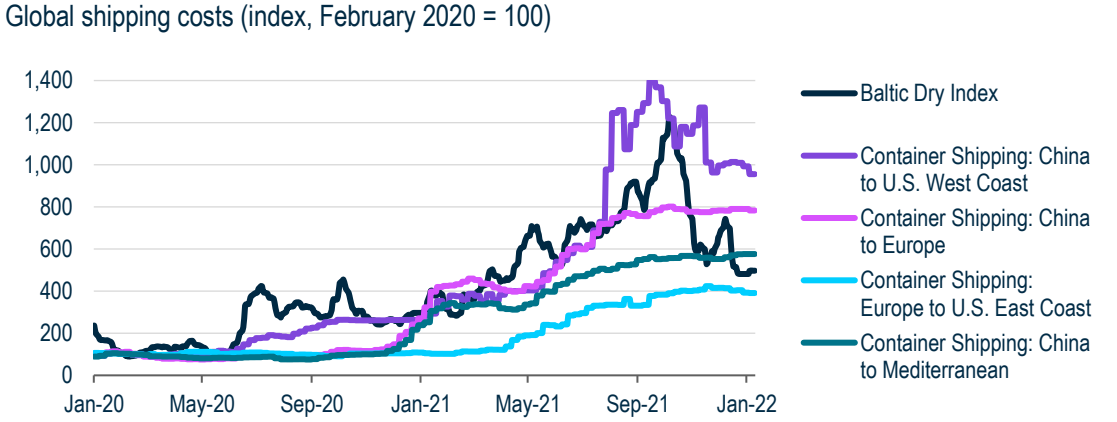
Source: JP Morgan, ISM, BEA. As of December 31, 2021.

One shouldn't rush to characterize the shipping shortages as being the only cause of the global supply chain issues.

With much of global manufacturing—particularly for durable consumer goods—concentrated in Asia, the region's supply constraints quickly spill over to the rest of the world, either via intermediate supply chains, such as those for semiconductors or durable goods including the infamous Peloton home gyms.

Demand for freight is also higher than normal in important commercial routes, but they have been particularly acute in the China-LA route, suggesting that the U.S. demand boom is behind these disruptions, and that one shouldn't rush to characterize the shipping shortages as being the only cause of the global supply chain issues.

Figure 2: Shipping costs rose materially as a result of COVID disruptions, but are starting to ease in some important routes



Source: Bloomberg, Freightos. As of January 10, 2022.

IS IT SUPPLY OR DEMAND?

In this section, we attempt to disentangle the role of supply and demand in the observed tightness[1] in the goods sector. This exercise is critical to formulating our views on the progression—and eventual resolution—of the inflationary pressures in the manufacturing sector.

BIG-DATA APPROACH

The first approach applies principal component analysis (PCA) to a number of tightness indicators in the manufacturing sector. Generally speaking, the PCA process identifies a set of unobserved and uncorrelated components that explain common variation in the tightness indicators. If such tightness indicators reflect a combination of unobserved supply and demand factors, we should be able to uncover the behavior of these drivers during the pandemic.

The tightness indicators used in the PCA model

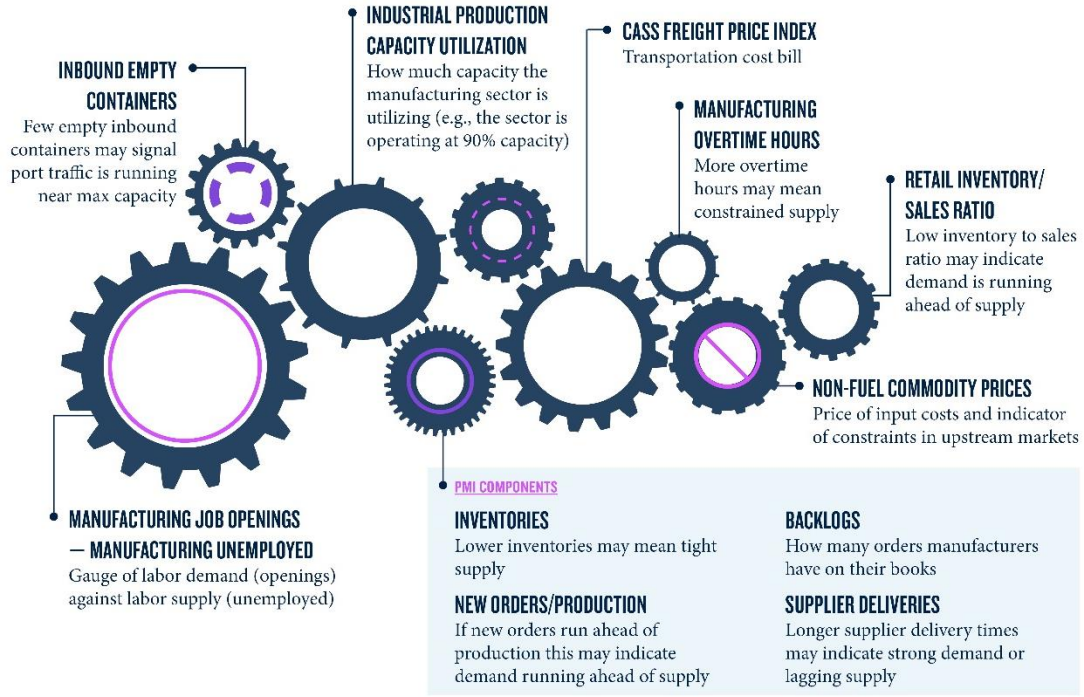


Figure 3 displays the first and second principal components from a set of tightness variables in the U.S. We make a couple of observations about the behavior of these components:

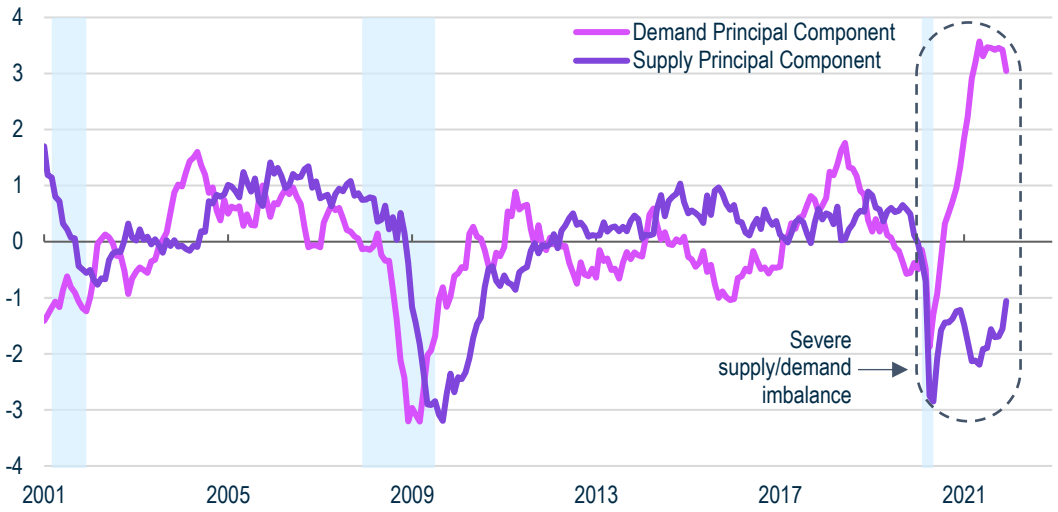
- The first principal component clearly drops in recessionary episodes, such as 2000, 2008 and early 2021, suggesting that it captures the weaker demand impact. However, the most recent drop was quickly reversed and the PC reached a historic high, indicative of a very strong demand recovery, and consistent with the extremely short duration of the recession.

- The second principal component also drops in recessions, albeit with a lag relative to the demand component. This suggests tighter supply after the onset of recessions as suppliers downshift operations. This time around the demand and supply components diverge sharply, indicating an acute inflationary supply/demand imbalance.

[1] We prefer to characterize manufacturing indicators consistent with inflationary pressures as indicative of "tightness" if we cannot isolate contributions from supply and demand.

Figure 3: Our principal component analysis shows a huge demand/supply imbalance

(Z-score)



Source: PGIM Fixed Income. As of January 10, 2022. Note: Shaded indicates recessions.

Taken together, these two series show the uniqueness of the current situation: unusually strong demand and very tight supply.

Taken together, these two series show the uniqueness of the current situation: unusually strong demand and very tight supply. Supply tightness is normally observed when demand expands and companies cannot keep up, leading to production lags. This is more extreme after recessions as firms' output is low and demand starts to recover, putting pressure on supply. Currently, however, the surge in demand further tightens supply pressures. As companies emerged from mandated lockdowns and other restrictions, they were unable to quickly scale up operations to their desired levels.

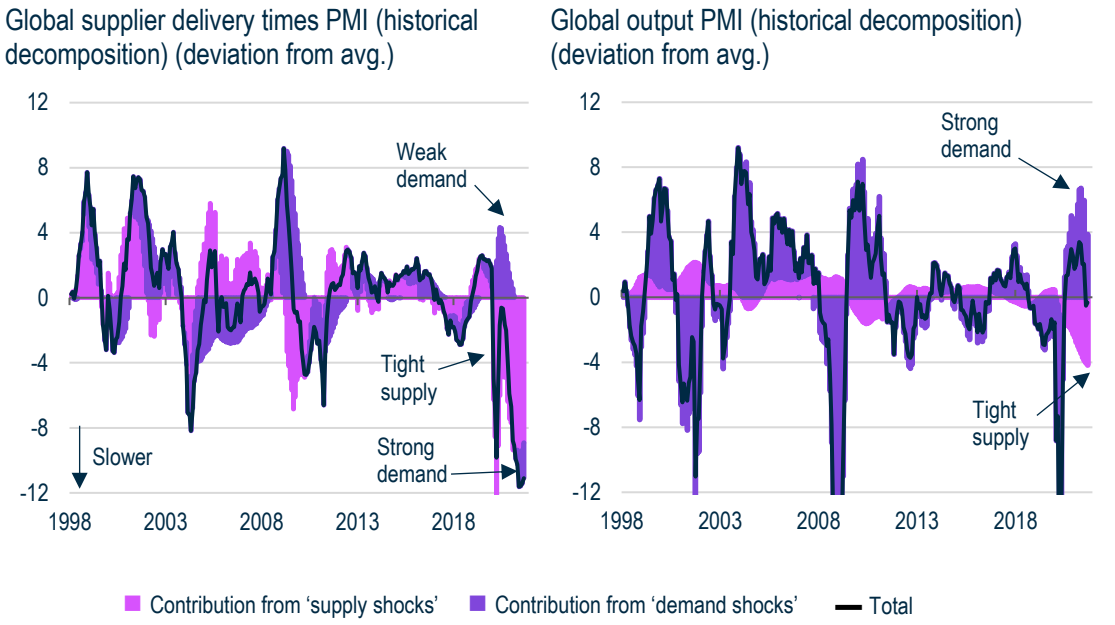
ECONOMETRIC APPROACH

In this section, we take a more structural approach to uncovering the impact of supply and demand on the manufacturing sector's tightness. To this end, we focus on global manufacturing PMI data for output and supplier delivery times in a vector autoregression (VAR) framework.

Our VAR framework provides an alternative method to disentangle impacts from supply and demand.[2] Figure 4 shows the decomposition of each PMI indicator into contributions from supply and demand variables.

[2] We perform a variance decomposition of the two variables after the estimation of the VAR and associate innovations in supplier delivery times with supply shocks and innovations in output with demand shocks.

Figure 4: Our econometric analysis shows that both supplier deliveries and manufacturing output were driven by demand and supply during the pandemic



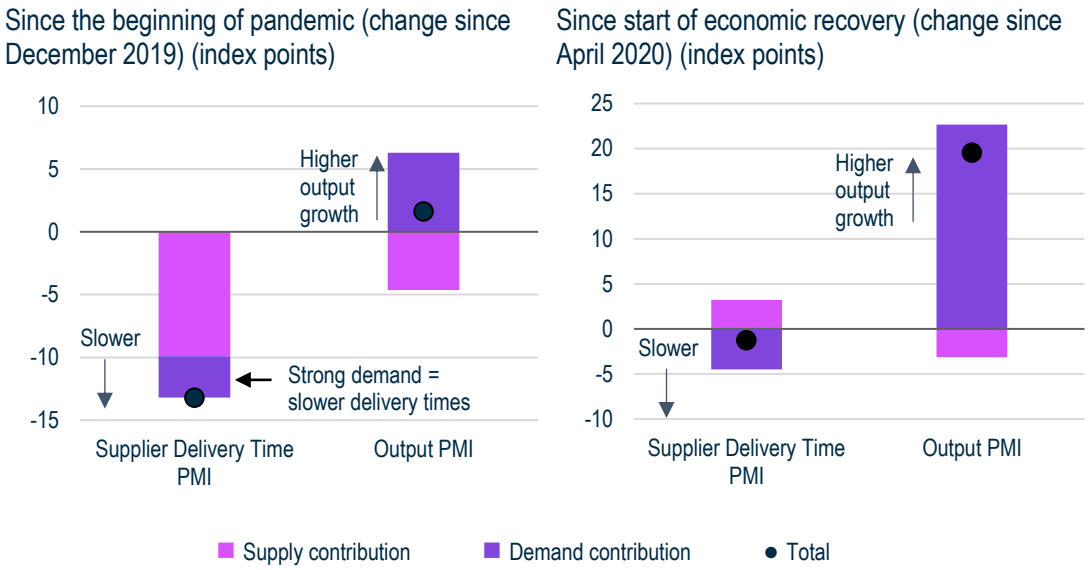
Source: PGIM Fixed Income. As of January 10, 2022.

DECOMPOSING THE CONTRIBUTION OF SUPPLY AND DEMAND

With the decomposition of the shocks at hand, we now turn to the question of which factor—supply or demand—is driving the tightness we are seeing in the manufacturing sector. Our frames of reference for this decomposition have two different starting points: since the beginning of the pandemic and since the start of the economic recovery beginning in May 2020.

According to our estimates, the decline in delivery times since the beginning of the pandemic was mostly driven by supply shocks (75%) relative to demand shocks (25%), while the rise in output was the result of a recovery in demand (60%) and tighter supply (40%). However, since the start of the economic recovery in May 2020—and contrary to the general perception that supply constraints are the main reason behind the tightness in manufacturing—our model shows that demand shocks were as important as supply shocks in clogging the sector, while demand shocks were responsible for over 90% of the rise in manufacturing output PMI, with tighter supply contributing only 10%.

Figure 5: Supply disruptions were prominent early in the pandemic, while demand was a more important driver in the reopening phase



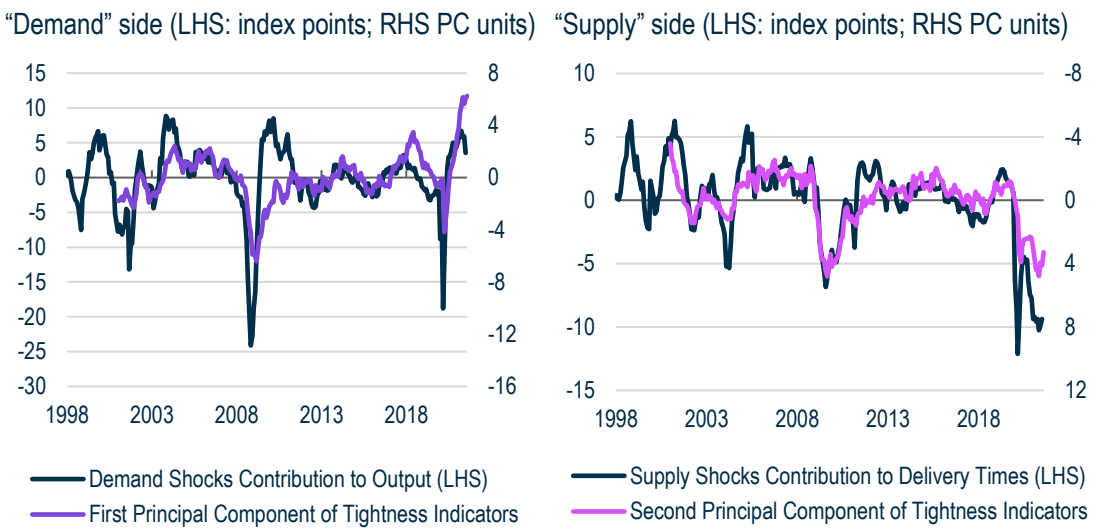
Source: PGIM Fixed Income. As of January 10, 2022.

These results suggest that early in the pandemic, lockdowns triggered both large supply and demand shocks. As the pandemic evolved, the supply shock was clearly disruptive for manufacturing output, leading to slower supplier deliveries, while demand only recovered with a lag. In the reopening phase, demand has recovered at a much faster pace than supply. We interpret this result as reflective of the unique impact of the pandemic on the economy. Lockdowns and other social distancing measures shifted demand from services to goods when massive fiscal and monetary support came online. This led to an explosion of demand that vastly outstripped supply capabilities.

As a check on the consistency of our results, Figure 6 compares the estimations of the supply and demand factors from the principal component and econometric approaches. The two estimations yield strikingly similar behaviors, increasing our confidence in the robustness of the results.[3]

[3] Despite regional differences between the first and the second approach (U.S. vs. Global) we interpret the similarity as further evidence of the integrated nature of global manufacturing.

Figure 6: Both our supply/demand decompositions yield strikingly similar behavior



Source: PGIM Fixed Income. As of January 10, 2022.

All told, our results indicate the tightness in the manufacturing sector is a supply ***and*** demand story, with demand recently showing a larger influence, especially in the reopening phase. In the following section we will map out our views on the future progression of these forces.

LOOKING FORWARD: THREE FACTORS THAT ALLEVIATE DISRUPTIONS

In order to assess whether disruptions in the manufacturing sector will be temporary or longer lasting, we find three key demand and supply drivers that determined the path of inflation and assess their likely path going forward. The evolution of each is an important part of the solution, and the following points underscore our base case for demand to moderate and supply to ease over the coming year.

1) COVID RESTRICTIONS AND THE SHIFT IN CONSUMPTION PATTERNS

The strict lockdowns at the start of the pandemic came at a cost as many businesses were forced to reduce their output or to stop operating altogether.

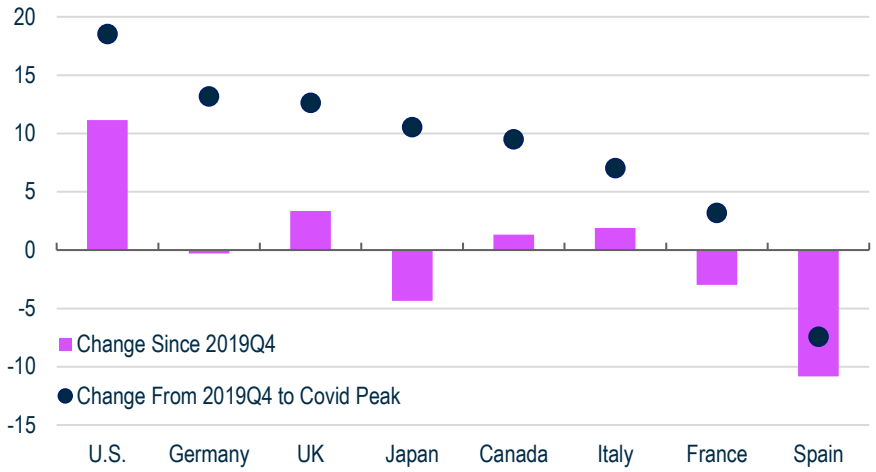
The goods demand boom appears to be moderating. In fact, in several countries durables consumption growth is now below pre-pandemic levels.

As households adapted to the lockdowns, they found substitutions for the services that they previously consumed. The boom in durables consumption was also visible in many developed economies (Figure 7). In Germany, for example, durables consumption rose at an annual rate of almost 14% from pre-pandemic levels to its post-pandemic peak.

This boom appears to be moderating. In fact, in several countries durables consumption growth is now below pre-pandemic levels. There are various reasons for this reversal: Households could be low on savings; they could be fully equipped with durables good at this point; and/or they could be less incentivized to consume as policy support starts to fade.

Figure 7: The durables consumption boom is starting to normalize in the developed world

Durable goods consumption (% SAAR)



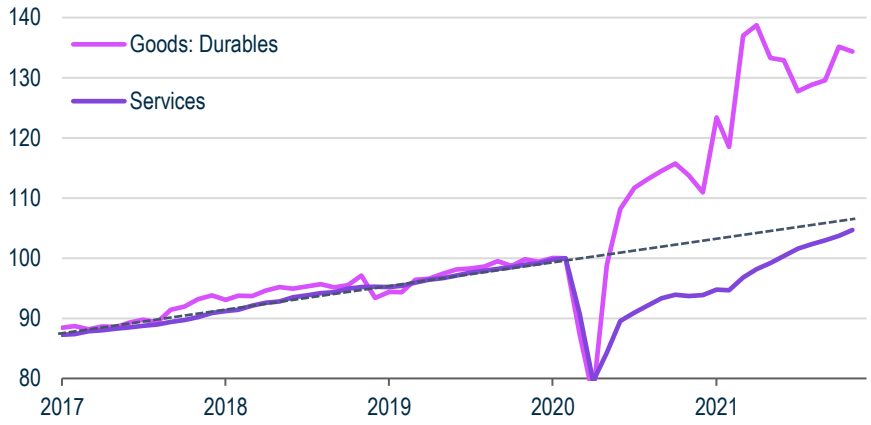
Source: Haver, OECD, National Statistical Agencies. As of January 10, 2022.

If one strips out those transfers, real disposable income would have been below its pre-pandemic trend.

Meanwhile, services consumption is recovering and is close to catching up to its pre-crisis trend (Figure 8). Progress on vaccinations and the availability of anti-viral drugs also facilitate a return to services consumption and a retracement in the demand for durables. The very large numbers of mostly mild infections from omicron also very likely leave a large gain in natural immunity in their wake. As was observed earlier in the year, when vaccine acquired immunity coincided with gains in spending, a similar pattern is now likely to emerge as people are more confident that their risk from the virus is more contained.

Figure 8: COVID-19 led to a big shift from services to durables goods consumption

U.S. PCE expenditures (index, February 2020 = 100)



Source: BEA. As of November 2021.

2) THE DEMAND BOOST FROM FISCAL SUPPORT, ESPECIALLY IN THE U.S.

In the U.S., the durables boom has been stronger and has moderated less than in other advanced economies. We suspect that policy support has been a major force behind the enduring demand. In the U.S., these measures included cash transfers to its citizens. Monetary policy also played a role, especially for asset-rich consumers who experienced positive wealth effects through the rising value of their properties and financial assets.

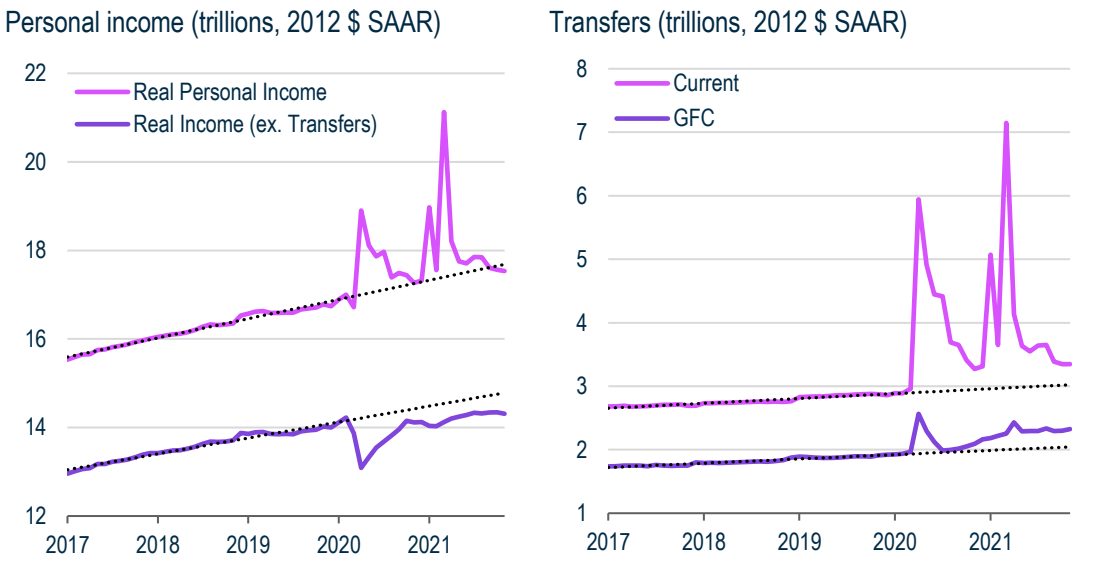
Figure 9 shows that fiscal transfers were a bigger source of income support than during the Global Financial Crisis. The chart on the left shows that those transfers boosted real income by up to 25% during the pandemic. If one strips out those transfers, real disposable income would

have been below its pre-pandemic trend. For the employed, those transfers meant higher savings. For the unemployed, those transfers supported their consumption.

These arguments also stand in other developed economies, perhaps with the caveats that fiscal stimulus was not as aggressive or consumer focused for these nations and that monetary policy may tighten more gradually as a result.

As transfers wane and the prospect of further fiscal stimulus dims, private consumption will face downside risks even though employment creation and higher savings should cushion the blow somewhat.

Figure 9: Cash transfers supported income of U.S. consumers



Source: BEA. As of November 2021.

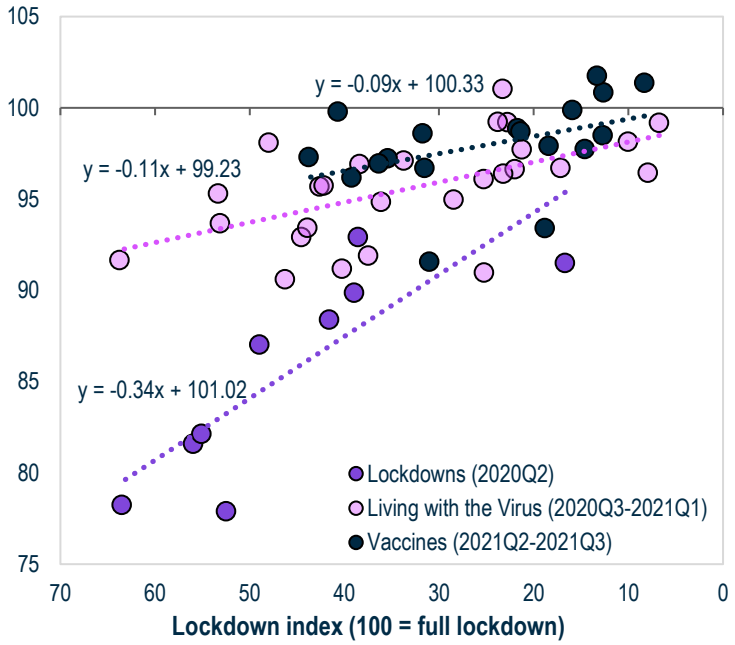
3) LEARNING TO LIVE WITH THE VIRUS: REDUCED SENSITIVITY OF OUTPUT TO COVID RESTRICTIONS

As COVID vaccines and treatments emerged, mobility restrictions started easing in the second half of 2020. In the developed world, economic output started to recover from the depths of the pandemic crisis. Interestingly, economic activity became less sensitive to COVID restrictions as these economies started reopening. This pattern became even clearer as vaccinations started in early 2021 (Figure 10).

Extrapolating from the trend is not without risks. While the Omicron variant has so far shown itself to be associated with much milder outcomes, it has been more transmissible, and vaccines appear to have not made much dent in its spread. There is always the possibility of more variants, which could mean renewed restrictions and disruptions in manufacturing. A particularly damaging scenario would be if China sticks with the zero-COVID approach or if other Asian economies tighten restrictions sharply. This could prove disruptive for manufacturing activity in Asia, the availability of shipping vessels, and the availability of intermediate inputs, such as semiconductors.

Figure 10: The effect of lockdown restrictions has been less disruptive for economic activity as the pandemic evolved

Output and lockdowns (Real GDP (2019 Q4 = 100))



Source: Haver, National Statistical Agencies, Goldman Sachs. As of November 2021. Note: Each dot is one quarter from the following set of countries: United States, Germany, France, Italy, Spain, United Kingdom, Japan, Canada, and Australia.

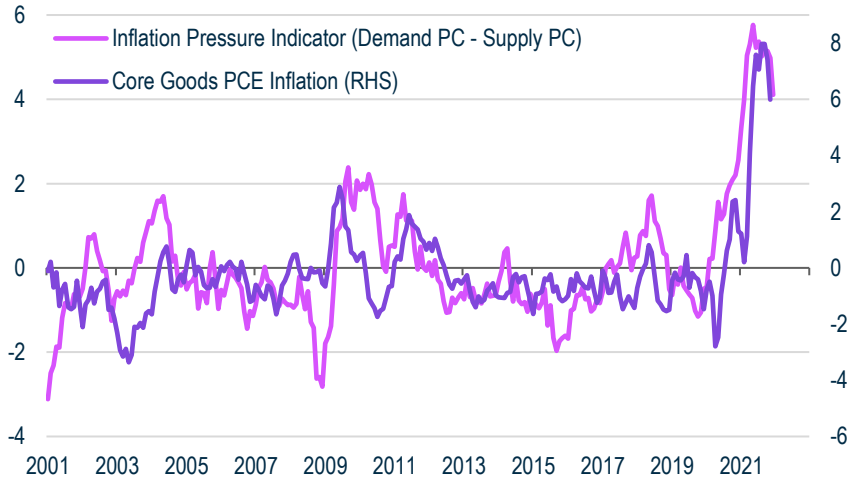
IMPLICATIONS FOR INFLATION

The latest available data shows signs of stabilization, suggesting that the demand/supply imbalance that has fueled inflation could be easing.

To gauge the effect of supply chain disruptions on inflation and its likely trajectory going forward, we return to our principal component framework. Using the model, we derive an indicator of inflation pressure by subtracting the supply component from the demand one. This gauges the extent to which demand is ahead or behind supply. This indicator has reached record levels and has clearly led to a surge in goods inflation (Figure 11). The latest available data shows signs of stabilization, suggesting that the demand/supply imbalance that has fueled inflation could be easing.

Figure 11: The huge demand/supply imbalance in the manufacturing sector led to a sharp rise in goods prices

(LHS: difference in z=scores; RHS: six-month % SAAR)



Source: PGIM Fixed Income, BEA. As of November 2021.

CONCLUSIONS

Contrary to conventional wisdom that supply constraints have been the main problem behind the global supply chain disruptions, we find evidence that strong demand has been a big driver of the tighter goods market. We show this using two different statistical approaches: principal components and econometric analysis.

The demand boom was fueled by policy stimulus, a shift from services to durables consumption, and the economic reopening following strict COVID restrictions, which makes the shortages situation more fixable.

Looking forward, as the demand boom reverses due to fading policy stimulus, a slowing global economy, and a switch back to services from durables consumption, supply chain issues should dissipate, and goods inflation should moderate, and the most recent data support this view. We also believe that continued re-opening of economies and better news on the virus should ultimately grease the wheels of global supply chains and eventually reduce the price pressures seen in the manufacturing sector. Overall, this means inflation should ease in 2022.

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Source(s) of data (unless otherwise noted): PGIM Fixed Income as of February 2022.

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