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Macroeconomic Consequences of Pandemic-Related Global Supply-Chain Disruptions

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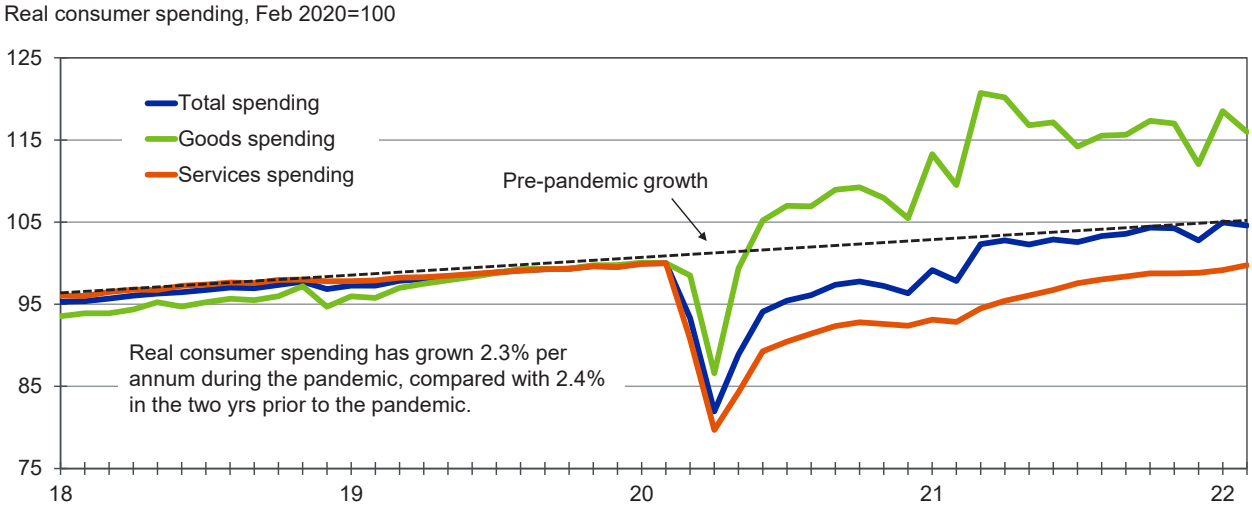
Macroeconomic Consequences of Pandemic-Related Global Supply-Chain Disruptions

MARK ZANDI, TIM UY AND BERNARD YAROS

Global supply chains have been badly scrambled since just after the COVID-19 pandemic struck more than two years ago. Factories and ports closed as nations in much of the world shut down their economies at different times to contain the highly infectious virus. Production and shipping were disrupted, resulting in shortages for a wide range of goods, much higher transportation costs, and inflation. In this note, we estimate the macroeconomic impact of these supply-chain disruptions on the U.S. economy.

Supply-chain problems first became evident in summer 2020 after nations partially reopened from the initial severe lockdowns. Demand for globally produced and shipped goods surged as households sheltering in place shifted their spending from activities such as travel, restaurants, recreational activities and other services (see Chart 1). Highly accommodative fiscal and monetary policies in much of the world also helped support household incomes and spending.

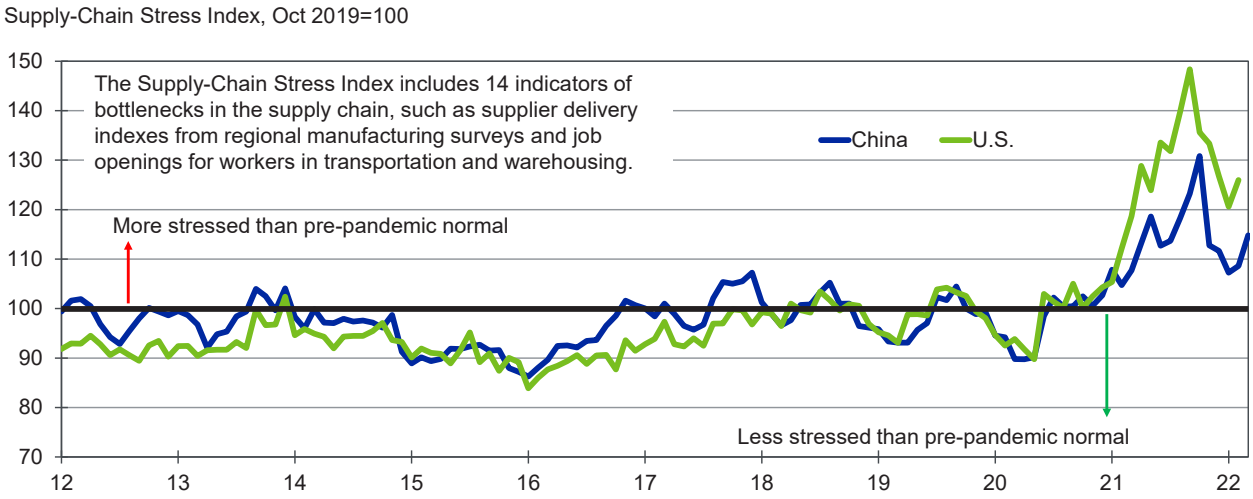
Chart 1: Goods Demand Surges at Reopening



Sources: BEA, Moody's Analytics

This stress in global supply chains is evident in our supply-chain stress indexes for the U.S. and China (see Chart 2). These indexes are a statistical compilation of a range of measures including global freight rates, purchasing managers' survey results, and labor availability in the transportation and warehousing industries.

Chart 2: Supply-Chain Stresses Ease



Sources: Multiple statistical sources, Moody's Analytics

Global supply-chain problems intensified in 2021, especially in the summer and fall as the Delta variant of the virus causing COVID-19 swept across the world, causing severe disruptions to industrial activity and shipping. Delta was notably tough on what at the time was a lightly vaccinated Asia, where most supply chains begin. Factories shut down throughout much of Southeast Asia and China's zero-COVID policy resulted in widespread port closures. Shortages of everything from semiconductors to plumbing fixtures quickly developed, inventories evaporated, and goods prices soared. Our supply-chain stress indexes suggest that the apex of supply-chain bottlenecks was in September at the height of the Delta wave, when the U.S. stress index spiked to nearly 150% of its pre-pandemic base.

Supply-chain stresses have since eased. Fortunately, the fast-moving Omicron wave that first appeared in December did only modest new damage to supply chains. Asian vaccination rates are now among the highest in the world, and businesses have begun to address the most severe supply bottlenecks. Semiconductor production, for example, has picked up and allowed the chip-reliant vehicle industry to ramp up output. Vehicle inventories will start to build this summer, and vehicle prices will come back to earth soon thereafter. More broadly, global trade rebounded smartly beginning at the end of last year, well ahead of production, suggesting supply-chain disruptions are easing.

Having said this, supply-chain stress remains elevated; the U.S. stress index sat at 126% in February. Moreover, China's current lockdowns to contain another wave of the virus are severely impacting Shanghai and other parts of the country that account for about one-third of the nation's GDP. This is a reminder of the threat the pandemic continues to pose to supply chains, inflation, and the broader economy.

Counterfactual scenario

To quantify the impact of scrambled global supply chains on the U.S. economy, we simulated our structural model of the global economy under the counterfactual that supply chains and non-energy goods consumer prices were not materially impacted by the pandemic. The counterfactual scenario begins in the third quarter of 2020 to coincide with the start of the supply-chain problems and ends in the first quarter of 2022, the most recent history for many economic variables.

The simulation allows monetary policy and the automatic stabilizers in federal government programs and the tax code to be determined endogenously by the model. We do not consider supply-chain disruptions to energy markets that have occurred since the start of this year, when oil, natural gas, and other commodity markets began to anticipate a Russian invasion of Ukraine.

Another important assumption in the counterfactual scenario is that consumer prices for non-energy goods would have increased 1.6% per annum beginning in the third quarter of 2020. This was our forecast for the coming decade even prior to the pandemic and is consistent with the pace of non-energy goods price increases in the 1990s prior to China's entry into the World Trade Organization. Given heightened trade tensions between the U.S. and China in recent years, rising production costs in China, and prospects for a stronger Chinese yuan, we have long anticipated higher goods price inflation in the coming years.

This assumed price growth for non-energy goods is also approximately consistent with a separate analysis we have performed of the impact of higher transportation costs during the pandemic on consumer price inflation. This analysis accounts for transportation costs' share of overall production input costs, the intermediate input content of final goods, and the pass-through of producer prices to consumer prices. A good rule of thumb is that for a sustained 10% increase in shipping costs, consumer prices ultimately rise 20 to 30 basis points per annum.

Macroeconomic impact

The economy's performance in the counterfactual scenario is compared with historical data available through the first quarter of this year and with our April 2022 baseline economic outlook through the end of 2024 (see Tables 1-7). Of course, history reflects the economic impact of disrupted supply chains, and our forecast assumes that supply chains will largely iron themselves out by this time next year.

As the counterfactual scenario shows, the supply-chain disruptions have led to much higher inflation and meaningfully weaker economic growth in the historical period through the first quarter of this year. Consumer price inflation, which was a painfully high 7.8% on a year-over-year basis through the first quarter of this year, is instead 4.5% in the counterfactual scenario. While still well above the Federal Reserve's inflation target of no higher than 2.5%, without the global supply disruptions inflation would not have become nearly the problem that it has.

It is worth noting that this estimated inflation impact of the supply-chain disruptions is larger than one based on simply adding up the contribution to the acceleration in inflation from higher prices for final goods directly impacted by supply-chain issues, such as vehicles, furniture and consumer electronics, to name a few. That is because our model simulation also captures the inflation effects of supply-chain disruptions on intermediate goods that ultimately impact final goods

Table 1: Consumer Price Impact of Supply-Chain Disruptions

	History			No supply-chain disruptions			Difference
	1982-1984=100	Ann. growth	% chg yr ago	1982-1984=100	Ann. growth	% chg yr ago	% Diff
2020Q1	258.6	1.3	2.1	258.6	1.3	2.1	0.0
2020Q2	256.4	-3.4	0.4	256.4	-3.4	0.4	0.0
2020Q3	259.4	4.8	1.3	258.6	3.4	0.9	-0.3
2020Q4	260.9	2.2	1.2	259.8	1.9	0.8	-0.4
2021Q1	263.5	4.1	1.9	262.7	4.6	1.6	-0.3
2021Q2	268.8	8.2	4.8	265.1	3.6	3.4	-1.4
2021Q3	273.2	6.7	5.3	267.6	3.8	3.5	-2.0
2021Q4	278.4	7.9	6.7	271.1	5.4	4.3	-2.6
2022Q1	284.1	8.4	7.8	274.6	5.3	4.5	-3.3
2020	258.8	1.2		258.4	1.1		-0.2
2021	271.0	4.7		266.6	3.2		-1.6

Note: Gray shaded area represents actual history

Sources: BLS, Moody's Analytics

Table 2: Real GDP Impact of Supply-Chain Disruptions

	History		No supply-chain disruptions		Difference
	2012$ bil	Ann. growth	2012$ bil	Ann. growth	2012$ bil
2020Q1	18,952	-5.1	18,952	-5.1	0
2020Q2	17,258	-31.2	17,258	-31.2	0
2020Q3	18,561	33.8	18,572	34.1	11
2020Q4	18,768	4.5	18,793	4.8	25
2021Q1	19,056	6.3	19,087	6.4	32
2021Q2	19,368	6.7	19,497	8.9	129
2021Q3	19,479	2.3	19,833	7.1	354
2021Q4	19,806	6.9	20,081	5.1	275
2020	18,385	-3.4	18,394	-3.4	9
2021	19,427	5.7	19,625	6.7	197

Note: Gray shaded area represents history

Sources: BEA, Moody's Analytics

Table 3: Nonfarm Employment Impact of Supply-Chain Disruptions

	History		No supply-chain disruptions		Difference
	Mil	Change, mil	Mil	Change, mil	Mil
2020Q1	151.9	0.3	151.9	0.3	0.0
2020Q2	133.8	-18.1	133.8	-18.1	0.0
2020Q3	140.5	6.7	140.5	6.8	0.1
2020Q4	142.5	2.0	142.6	2.1	0.2
2021Q1	143.7	1.3	144.0	1.3	0.3
2021Q2	145.2	1.5	145.7	1.7	0.5
2021Q3	146.9	1.7	147.6	1.9	0.7
2021Q4	148.6	1.8	149.7	2.0	1.0
2022Q1	150.4	1.8	151.8	2.1	1.4
2020	142.1	-8.7	142.2	-8.7	0.1
2021	146.1	4.0	146.7	4.5	0.6

Note: Gray shaded area represents history

Sources: BLS, Moody's Analytics

Table 4: Unemployment Rate Impact of Supply-Chain Disruptions

	History %	No supply-chain disruptions %	Difference %
2020Q1	3.8	3.8	0.0
2020Q2	13.0	13.0	0.0
2020Q3	8.8	8.8	0.0
2020Q4	6.8	6.7	-0.1
2021Q1	6.2	6.1	-0.1
2021Q2	5.9	5.7	-0.2
2021Q3	5.1	5.0	-0.1
2021Q4	4.2	4.3	0.0
2022Q1	3.8	3.4	-0.4
2020	8.1	8.1	0.0
2021	5.4	5.3	-0.1

Note: Gray shaded area represents history

Sources: BLS, Moody's Analytics

Table 5: New-Vehicle Sales Impact of Supply-Chain Disruptions

	Apr 2022 baseline		No supply-chain disruptions		Difference
	Mil	Change, mil	Mil	Change, mil	Mil
2020Q1	15.0	-1.9	15.0	-1.9	0.0
2020Q2	11.3	-3.7	11.3	-3.7	0.0
2020Q3	15.4	4.1	15.4	4.2	0.0
2020Q4	16.2	0.8	16.3	0.9	0.1
2021Q1	16.8	0.6	17.0	0.7	0.2
2021Q2	16.9	0.1	17.0	0.0	0.1
2021Q3	13.3	-3.5	16.9	-0.1	3.6
2021Q4	12.9	-0.5	16.9	-0.0	4.0
2022Q1	14.9	2.0	17.1	0.2	2.3
2020	142.1	-8.7	14.5	-8.7	0.0
2021	146.1	4.0	17.0	2.4	2.0

Note: Gray shaded area represents history

Sources: BEA, Moody's Analytics

Table 6: Federal Funds Rate Impact of Supply-Chain Disruptions

	Apr 2022 %	No supply-chain disruptions %	Difference %
2020Q1	1.2	1.2	0.0
2020Q2	0.1	0.1	0.0
2020Q3	0.1	0.1	0.0
2020Q4	0.1	0.1	0.0
2021Q1	0.1	0.1	0.0
2021Q2	0.1	0.1	0.0
2021Q3	0.1	0.1	0.0
2021Q4	0.1	0.3	0.2
2022Q1	0.1	0.7	0.6
2020	0.4	0.4	0.0
2021	0.1	0.1	0.1

Note: Gray shaded area represents history

Sources: Federal Reserve, Moody's Analytics

Table 7: 10-Year Treasury Yield Impact of Supply-Chain Disruptions

	Apr 2022 %	No supply-chain disruptions %	Difference %
2020Q1	1.4	1.4	0.0
2020Q2	0.7	0.7	0.0
2020Q3	0.7	0.7	0.0
2020Q4	0.9	1.0	0.1
2021Q1	1.3	1.4	0.1
2021Q2	1.6	1.7	0.1
2021Q3	1.3	1.7	0.4
2021Q4	1.5	1.9	0.4
2022Q1	2.0	2.4	0.5
2020	0.9	0.9	0.0
2021	1.4	1.7	0.2

Note: Gray shaded area represents history

Sources: Federal Reserve, Moody's Analytics

prices. The poster child for this would be building materials, which add to construction costs and eventually to the cost of housing services.

Real GDP is also meaningfully higher in the counterfactual scenario. As of the fourth quarter of 2021, the most recent available history, real GDP is $275 billion, or 1.4%, higher in the counterfactual. That is, if not for the global supply-chain problems, real GDP would have been 1.4% higher at the end of last year. The biggest hit to real GDP was $354 billion, or 1.8%, when the Delta wave was doing its most serious damage to supply chains and the economy in the third quarter of last year.

The biggest lift to GDP in the counterfactual scenario comes from greater vehicle sales and production. Global vehicle markets have been badly disrupted by a string of supply-chain issues, most notable when the Delta wave forced Asian semiconductor plants to stop operations in the fall. The resulting chip shortages hammered global vehicle production, causing vehicle inventories to collapse and vehicle prices to surge. We estimate there would have been 2 million more vehicle sales in 2021 if supply chains had been able to function normally. Homebuilding has also been significantly impaired, as builders have been unable to get the materials needed to complete homes because of supply-chain problems. Evidence of this is the near record more than 1.6 million single- and multifamily homes in some stage of completion. Dynamics in vehicle and house prices have contributed meaningfully to movements in the CPI.

With higher GDP in the counterfactual scenario, there are also more jobs and lower unemployment. If there had been no supply-chain disruptions, employment would have been 1.4 million jobs higher as of the first quarter of this year, the most recent history available, and the unemployment rate would have been 3.4%, or 0.4 percentage point lower. Limiting the decline in unemployment in the scenario is a bigger and sooner increase in labor force participation and foreign immigration as the tighter labor market and stronger wage growth attract more people into the labor force faster.

Given the stronger growth and lower unemployment, and despite the lower inflation, the Federal Reserve begins to normalize monetary policy more quickly in the counterfactual scenario, which also helps push up

long-term interest rates more quickly. Both the federal funds rate and 10-year Treasury yield are about 0.5 percentage point higher as of this year's first quarter in the counterfactual scenario than they actually were.

Conclusions

The COVID-19 pandemic has been a massive supply-side shock to the economy, hurting growth and lifting inflation. The surprising, unprecedented scrambling of global supply chains has been a critical aspect of this supply-side blow. It undermined the economy's ability to produce and deliver goods, causing shortages, lifting inflation and destroying demand. No doubt, even if there had not been severe supply-chain problems, the economy still would have struggled mightily and inflation still would be uncomfortably high, but this analysis shows that this struggle would not have been nearly as difficult or prolonged.

About the Authors

Mark Zandi is chief economist of Moody's Analytics, where he directs economic research. Moody's Analytics, a subsidiary of Moody's Corp., is a leading provider of economic research, data and analytical tools. Dr. Zandi is a cofounder of Economy.com, which Moody's purchased in 2005.

Dr. Zandi's broad research interests encompass macroeconomics, financial markets and public policy. His recent research has focused on mortgage finance reform and the determinants of mortgage foreclosure and personal bankruptcy. He has analyzed the economic impact of various tax and government spending policies and assessed the appropriate monetary policy response to bubbles in asset markets.

A trusted adviser to policymakers and an influential source of economic analysis for businesses, journalists and the public, Dr. Zandi frequently testifies before Congress on topics including the economic outlook, the nation's daunting fiscal challenges, the merits of fiscal stimulus, financial regulatory reform, and foreclosure mitigation.

Dr. Zandi conducts regular briefings on the economy for corporate boards, trade associations and policymakers at all levels. He is on the board of directors of MGIC, the nation's largest private mortgage insurance company, and The Reinvestment Fund, a large CDFI that makes investments in disadvantaged neighborhoods. He is often quoted in national and global publications and interviewed by major news media outlets, and is a frequent guest on CNBC, NPR, Meet the Press, CNN, and various other national networks and news programs.

Dr. Zandi is the author of *Paying the Price: Ending the Great Recession and Beginning a New American Century*, which provides an assessment of the monetary and fiscal policy response to the Great Recession. His other book, *Financial Shock: A 360º Look at the Subprime Mortgage Implosion, and How to Avoid the Next Financial Crisis*, is described by The New York Times as the "clearest guide" to the financial crisis.

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