

Alberto Cavallo

Associate Professor
Harvard Business School



Oleksiy Kryvtsov

Senior Research Officer
Bank of Canada



What can stockouts tell us about inflation? Evidence from online micro data¹

The issue

Rising inflation in 2021 spurred a lively debate on its causes. COVID-related supply disruptions and cost pressures are often mentioned by policymakers and economists as playing a role, but little is known empirically about their actual impact on prices. The rich variation of prices and shortages during the pandemic provides a good opportunity to analyze their mutual relationship.

Data

In this paper, we provide a direct high-frequency measure of consumer product shortages during the pandemic. The measure captures product unavailability in the microdata collected on a daily basis from the websites of 70 large retailers in seven countries – the United States, Canada, China, France, Germany, Japan, and Spain – from November 1, 2019 to July 26, 2022. The dataset spans a wide range of consumer goods, including food and beverages, household, health, electronics and personal care products, covering between 62% and 80% of the goods consumption weights in the consumer price index (CPI) baskets of these countries. The dataset contains prices for almost two million products, allowing us to evaluate the rich time and cross-section details to assess the inflationary effects of shortages.

Stockout dynamics

There are three distinct patterns of stockout behavior that are common across most sectors and countries

during this period. First, there was a widespread increase in shortages early in the pandemic affecting nearly all categories of consumer goods. In the United States, in particular, our aggregate measure of stockouts using CPI category weights rose from a pre-pandemic level of around 10% in 2019 to over 40% in May 2020. Initially, the stockouts impacted health and personal care goods, but quickly spread to other categories, with increases ranging from 23 percentage points for “furnishings and household” goods and over 60 percentage points for “food and beverages.” The level of aggregate US stockouts recovered gradually over time and by January 2022 they were about 15 percentage points above their pre-pandemic levels. Other countries exhibit similar stockout dynamics, but the US had the most persistent stockouts.

Second, the composition of shortages changed significantly over time. Temporary stockouts, which are more visible to consumers because they are flagged by retailers with an out-of-stock indicator, rose sharply in most sectors and countries early on and then recovered rather quickly. By the end of 2020, they had fallen below their pre-pandemic levels for most countries in our sample. By contrast, permanent stockouts – measured by net discontinued products – remained elevated in some countries throughout the pandemic. In the US, they were still at half their peak levels by January 2022.

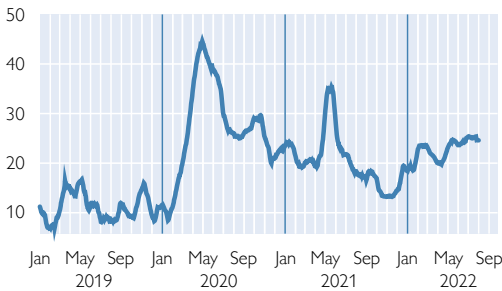
¹ See Cavallo and Kryvtsov (2021). The updated paper is available on the authors' websites. Alberto Cavallo is a shareholder of PriceStats LLC, the private company that provided proprietary data used in this paper without any requirements to review the findings. The views expressed here are ours, and they do not necessarily reflect the views of the Bank of Canada.

Chart 1

Stockouts in the United States, 2019–2022

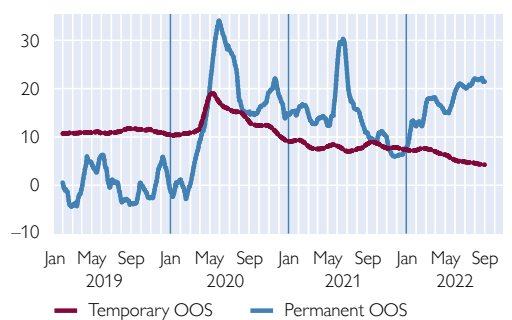
(a) All stockouts

Percentage points, 30-day moving average



(b) Temporary and permanent stockouts

Percentage points, 30-day moving average



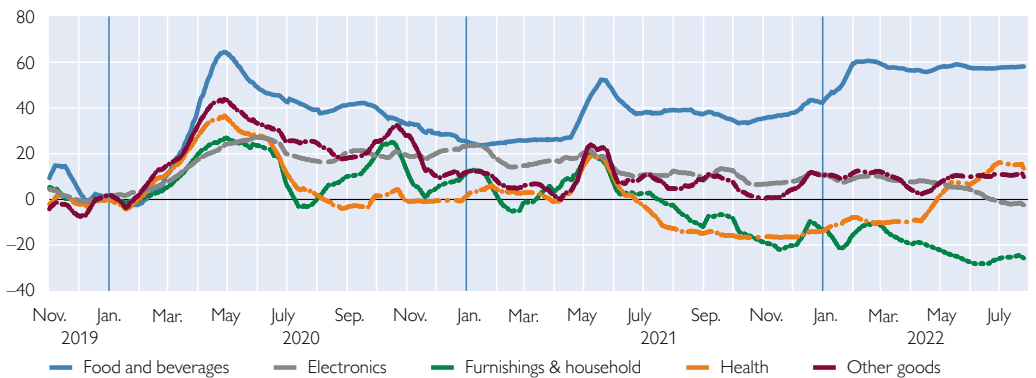
Note: OOS - out-of-stock.

Source: Cavallo and Kryvtsov (2021). The updated paper is available on the authors' websites.

Chart 2

All stockouts in US sectors

Percentage points, 30-day moving average

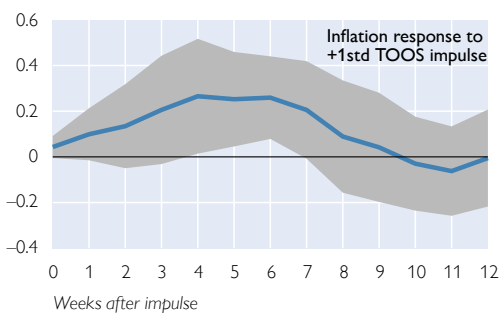


Source: Cavallo and Kryvtsov (2021). The updated paper is available on the authors' websites.

Chart 3

Responses to a stockout shock in a three-digit sector in seven countries

Inflation response, annual percentage points



Source: Cavallo and Kryvtsov (2021). The updated paper is available on the authors' websites.

Note: std – standard; TOOS – temporary stockout.

Third, stockouts became increasingly concentrated in fewer product categories over time. In particular, in the United States stockouts remained persistently high for the "food and beverages" category, but returned to pre-pandemic levels in other major categories.

Stockouts and inflation

Next, we show that these product shortages were associated with rising prices in most sectors and countries. The magnitude of the dynamic inflationary effect of shortages is statistically and economically significant. We estimate

that an unexpected doubling of the weekly temporary stockout rate from 10% to 20% brought about a 1.5 percentage-point increase in the annualized inflation rate in a three-digit sector. The inflation response takes about a month to reach its peak and lasts approximately three months.

International trade and stockouts

To investigate whether the inflationary effects are associated with global supply bottlenecks, we study the behavior of imported products and import-intensive sectors. First, using microdata from one large US retailer with country-of-origin information for all individual goods, we show that imported products experience both longer stockouts and higher inflation rates than domestically produced goods. After a temporary stockout, prices of domestically produced products quickly return to average levels, whereas prices of imported goods continue to rise for several weeks.

Second, when we compare sector responses to temporary stockout disturbances, import-intensive sectors experience larger and more persistent inflation, with roughly twice the impact of domestic goods after six weeks. Overall, this evidence suggests that costs associated with supply-chain disruptions during the pandemic led to significant

increases in both product shortages and price increases.

Inventory costs, prices and stockouts

In the final part of the paper, we estimate the cost of replenishing inventories by explicitly accounting for the endogeneity of stockouts. The influence of inventories on prices is especially strong in recessions. Building on Kryvtsov and Midrigan (2013), we develop a model of joint dynamics of stockouts and prices in a sector facing exogenous demand and cost disturbances, and use it to derive an empirical specification for estimating the underlying costs. We then construct empirical responses of sector stockouts and inflation to the estimated cost shocks.

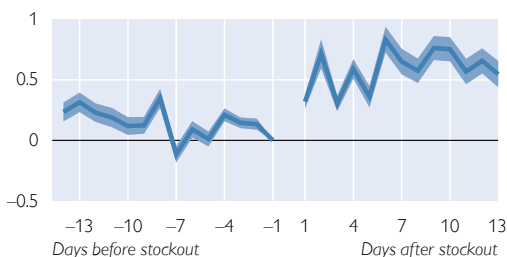
Our estimation results imply a statistically and economically significant link between costs, temporary stockouts and inflation. The estimated cost dynamics resemble those from observed stockout behaviors, validating the idea of using shortages for gauging the emergent cost pressures. Furthermore, accounting for the endogeneity of stockouts makes the estimated inflationary effects stronger immediately after the cost shock, but also less persistent. We also find that both inflation and stockouts are more responsive in trade-intensive

Chart 4

Price levels before and after a stockout for a large US retailer

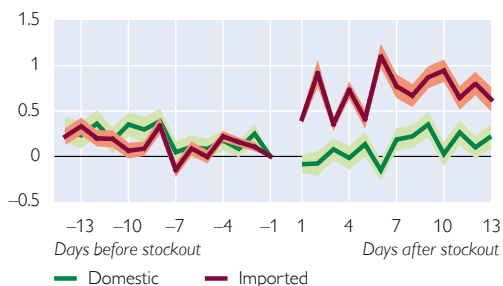
(a) All price changes

Price-relative, percentage points



(b) Domestic versus imported goods

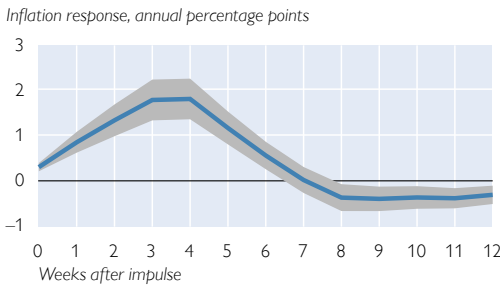
Price-relative, percentage points



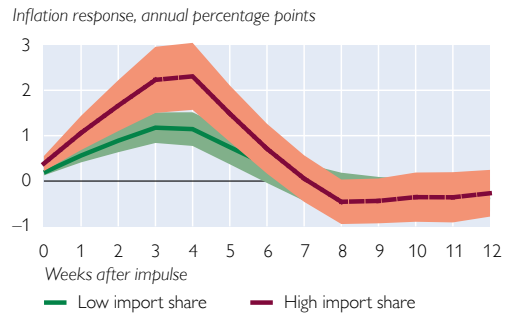
Source: Cavallo and Kryvtsov (2021). The updated paper is available on the authors' websites.

Responses to real replacement cost shocks in three-digit sectors, in seven countries

Inflation response to +1 standard deviation real cost impulse (TOOS)



Inflation response to +1 standard deviation real cost impulse (TOOS)



Note: TOOS – temporary stockouts.

Source: Cavallo and Kryvtsov (2021). The updated paper is available on the authors' websites.

sectors, suggesting that retailers more exposed to international trade experienced higher cost pressures during the pandemic.

Conclusions

Product shortages likely reflect emergent cost pressures due, in part, to supply bottlenecks. Unexpected shortages are quickly followed by inflation. During a protracted event, such as a global health pandemic, the shortages are temporary at first but gradually become more permanent in nature and increasingly

concentrated in some sectors. Persistently high inflation rates in these sectors can be explained by a series of adverse cost shocks, for example, due to recurring waves of virus infections. As cost pressures dissipate, the inflation outlook will increasingly depend on other factors, such as the effect of the fiscal stimulus, the adjustment of inflation expectations, geopolitical shocks and the diffusion of cost pressures via domestic and international production networks.

References

Cavallo, A. and O. Kryvtsov. 2021. What Can Stockouts Tell Us About Inflation? Evidence from Online Micro Data. NBER Working Papers 29209. National Bureau of Economic Research, Inc. <https://ideas.repec.org/p/nbr/nberwo/29209.html>

Kryvtsov, O. and V. Midrigan. 2013. Inventories, Markups, and Real Rigidities in Menu Cost Models. *Review of Economic Studies*, 80(1). 249–276.

