Supply Disruptions and Fiscal Stimulus: Transmission through Global Value Chains

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The global COVID-19 response involved a series of policy interventions that triggered both demand and supply shocks. First, in response to the global health crisis, governments worldwide implemented lockdown policies of various intensities as a measure to curb the spread of the virus. Second, governments introduced extraordinary fiscal support aimed at alleviating the socio-economic effects of the pandemic. These measures contributed to a shift in consumer spending from services to goods, supply shortages, and price increases (LaBelle and Santacreu, 2022; de Soyres, Santacreu and Young, 2023; di Giovanni et al., 2023). As the economy started re-opening with the roll-out of vaccines and lifting of lockdowns, consumer spending patterns returned to services, alleviating supply chain disruptions and goods inflation.

While there is a widespread consensus attributing bottlenecks at the pandemic's onset to a combination of demand and supply factors, measuring the specific contribution of each component is not an easy task. Governments worldwide implemented rapid and diverse policy responses, which included lockdowns, fiscal stimulus packages, and other interventions. The sheer magnitude and speed of these policy measures, combined with the unprecedented shocks to both demand and supply, make it difficult to disentangle their individual effects on bottlenecks. In this paper, we integrate fiscal spending and mobility measures with supply constraint indicators, both domestic and foreign, to study the interplay among these factors and their impact on bottlenecks and inflation globally.

Our paper complements recent work analyzing the effect of supply and demand forces. In a Federal Reserve Bank of New York Liberty Street Economics blog post, the authors construct an index of global supply chain pressures that removes demand factors.[1] Amiti et al. (2023) study the impact of shocks in the domestic labor market and disruptions in import supply chains on US inflation. di Giovanni et al. (2022) study, through the lens of a quantitative model, the impact of the COVID-19 pandemic on Euro Area inflation and find that that foreign shocks have an important impact on inflation. di Giovanni et al. (2023) find that roughly two-thirds of model-based U.S. inflation is linked to aggregate demand shocks, with fiscal stimulus contributing at least half of the overall aggregate demand effect. Comin, Johnson and Jones (2023) find, using a New-Keynesian model, that binding capacity constraints explain half of the increase in inflation during 2021-2022. Finally, the international propagation of foreign demand and supply shocks on economic activity during the pandemic has been studied in recent work (see Bonadio et al., 2021; Santacreu, Leibovici and LaBelle, 2021). Our contribution lies in empirically evaluating the correlation between the variables of interest without the need to impose assumptions on the underlying structure.

Our analysis proceeds in two steps. First, we investigate how supply and demand factors, both domestic and foreign, propagated through global value chains (GVCs), contribute to bottlenecks. Here, bottlenecks are an endogenous variable shaped by the

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[1]See more at: `https://shorturl.at/mnGP1`.

dynamics of supply and demand forces. Second, we use bottlenecks as an explanatory variable to study their impact on sectoral inflation, controlling for other relevant variables that may influence inflation but are not directly related to bottlenecks (past inflation, labor market conditions, etc.). In our analysis, and different from previous work, we distinguish between inflation in goods and services to account for the interaction between fiscal stimulus and the shift in consumption preferences at the onset of the pandemic. Moreover, we investigate how foreign shocks propagate through supply chains.[2]

Our main findings are as follows: (i) Supply constraints bind during periods of high demand; (ii) The effect of foreign exposure is more significant in open markets and less in emerging markets; (iii) While effective in normal times, perfect diversification of import partners does not yield significant benefits during a global shock; (iv) Bottlenecks impact headline inflation through their effect on core goods, while there is no association with core services; and (v) At the peak, bottlenecks contribute to about half of excess inflation in the US, approximately a third in Advanced Foreign Economies (AFEs), and around a quarter in Emerging Market Economies (EMEs). Our results highlight the significant role of fiscal support, its interaction with supply forces, and its international propagation in shaping the dynamics of bottlenecks and inflation. This emphasizes the need for explicitly modeling fiscal shocks to understand these dynamics.

I. Bottlenecks: Supply and Demand

Bottlenecks result from an imbalance between supply and demand, each composed of both domestic and foreign components. We examine how domestic bottlenecks are associated with the conjunction of three elements: (i) changes in observed domestic mobility, serving as a proxy for COVID-19 related domestic supply and demand disruptions; (ii) government fiscal spending, assumed to support aggregate demand; and (iii) exposure to foreign bottlenecks, since domestic production can be affected by disruptions in countries that supply inputs.

BOTTLENECKS

We analyze bottlenecks using the Purchasers Managers' Index (PMI), which comprise monthly surveys sent to senior executives at private firms in 37 countries. In particular, we use the Supply Delivery Times (SDT) sub-index, which captures how managers characterize the extent of the delays they are experiencing in delivering orders. Higher values mean that customers are not getting their purchases in a timely manner, which is a proxy for production bottlenecks.

MOBILITY

To track changes in mobility during the pandemic, we rely on data from the COVID-19 Google Mobility Trends. This dataset covers the period from February 2020, marking the onset of the pandemic, to October 2022. It leverages mobile phone data to construct a comprehensive mobility index across multiple countries. We smooth the average of the mobility indices using standard splines.[3]

FISCAL SUPPORT

To measure government fiscal support, we use IMF's World Economic Outlook data from October 2023 and consider the percentage point deviation in government expenditure as a share of GDP compared to the 5-year average before the pandemic. To account for delayed household spending, we create cumulative versions which capture the total support received over time.[4]

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[2]Our international focus also allows us to explore the propagation effects of foreign fiscal stimulus measures on domestic bottlenecks, an issue we investigate in more details in de Soyres et al. (2023).

[3]The mobility index is highly correlated with the Oxford stringency index, which reflects the stringency of measures that impact people's mobility and aim to reduce the potential for the virus to spread. Note that the results remain robust even without smoothing the average of the mobility indices.

[4]We performed robustness tests on the definition of fiscal support. In particular, our results are robust to

Exposure to foreign disruptions

To investigate how supply disruptions propagate across countries, we use the 2023 edition of OECD Trade in Value Added (TIVA) dataset and compute an index of exposure to foreign bottlenecks. For country c at time t, the index is defined as:

$$(1) \qquad \text{Exp. Fgn. Bottleneck}_{ct} =$$
$$\sum_{j \in P_{ct}} \frac{FVA_{j \to c}}{GDP_c} \cdot \text{Bottleneck}_{jt}$$

where Bottleneck_{jt} represents the PMI index sub-component—i.e., SDT—reflecting bottlenecks in partner j at time t, and P_{ct} is the set of country c's trade partners. The variable $FVA_{j \to c}$ is the foreign value added produced in country j and used in country c's exports and domestic consumption. Note that the ratio $\frac{FVA_{j \to c}}{GDP_c}$ is fixed to the pre-pandemic period, specifically 2018. The variable GDP_c represents Gross Domestic Product (GDP) of country c and scales for the size of the country. Scaling foreign value added by GDP helps to account for trade openness, which tends to be larger in smaller countries.

Econometric Model and Results

To explore the interplay between mobility, fiscal spending, and international propagation of foreign disruptions on domestic bottlenecks, we estimate the following specification:

$$(2)$$
$$\text{Bottleneck}_{ct} = \underset{(0.059)}{-0.196^{***}} \cdot \text{Mobility}_{ct}$$
$$+ \underset{(0.006)}{0.013^{**}} \cdot \text{Mobility}_{ct} \times \text{Fiscal Sup.}_{ct}$$
$$+ \underset{(0.416)}{3.392^{***}} \cdot \text{Exp. Fgn. Bottlheneck}_{ct}$$
$$- \underset{(0.477)}{1.204^{***}} \cdot \text{Exp. Fgn. Bottleneck}_{ct} \times \text{EMEs}$$
$$+ \text{FEs} + \varepsilon_{ct}$$

Bottlenecks are strongly correlated with pandemic mobility restrictions, as evidenced by the first term in equation (2).[5] The negative sign suggests that increased mobility, driven by the vaccine rollout and the gradual easing of lockdown measures, is associated with the alleviation of domestic bottlenecks. The interaction term in our analysis shows the relationship between fiscal support and the bottleneck-mobility connection. Since fiscal support varies by country, the coefficient indicates the difference in how bottlenecks respond to mobility changes in countries with different levels of fiscal support. The opposite sign of the coefficient, compared to the standalone mobility term, implies that higher fiscal support hampered the reduction of bottlenecks as mobility recovered in 2021 and 2022. This is consistent with the idea that supply disruptions are binding in periods of strong demand (Comin, Johnson and Jones, 2023), and suggests that fiscal support contributed to the persistence of bottlenecks during the reopening of the economy. Finally, the strongly positive and significant coefficient for the exposure to foreign bottlenecks highlights the interconnection between domestic and foreign production processes. This connection is weaker for EMEs.

Using the estimated coefficients from equation (2), we conduct back-of-the-envelope calculations to further investigate how bottlenecks are shaped by the interplay between fiscal support, mobility, and exposure to foreign disruptions. We study the effect of a globally synchronized 20 percentage point increase in mobility, and compute its effect on the reduction of bottlenecks in all countries. Each country's bottleneck is shaped by its own fiscal support as well as its exposure to foreign bottlenecks. Hence, the effect of a global change in mobility is determined by the fixed point solution that accounts for all countries' reactions and their international propagation

using the primary fiscal balance measured by "General government net lending/borrowing" in the IMF WEO data, in deviation from the pre-pandemic 5-year average.

[5]Our baseline specification includes country-year and month fixed effects and relies on using both cross-country and time-series variations. Standard errors are shown in parenthesis below each estimated coefficient. *** (resp. **) indicated significance at the 1 (resp. 5) percent level. Our sample contains 962 observations and the R-squared of the regression is equal to 0.86.

through GVCs.[6] We investigate the effect of a synchronized increase in mobility under four scenarios: (i) with the observed fiscal support as in the data; (ii) without domestic fiscal support; (iii) without fiscal support in the US; and (iv) without any fiscal support globally. In addition, we study the role of foreign exposure by (i) eliminating foreign exposure; and (ii) considering a counterfactual scenario where all countries are perfectly diversified. We find that countries with large fiscal support experienced a smaller reduction in bottlenecks, suggesting strong demand effects. Moreover, in the US, domestic fiscal support was more important than foreign fiscal support propagated through GVCs (see Figure 1).
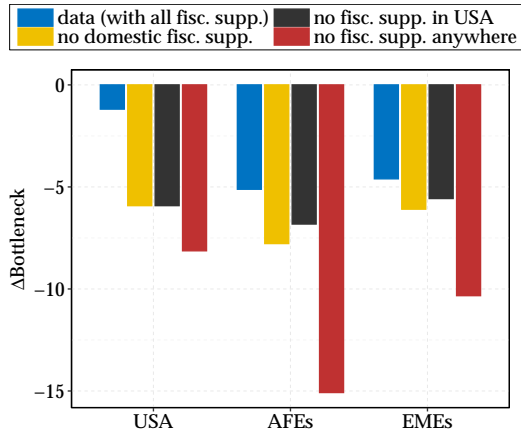

Fig. 1. Bottlenecks and Mobility

Note: The chart shows the bottleneck reduction associated with a synchronized 20 percentage points increase in mobility in all countries, using the point estimates from regression 2. Different colors show the results obtained in scenarios with different level of Fiscal Support.

Consistently, we also find that the US was less affected to exposure to foreign bottlenecks than more open economies (see Figure 2). Finally, additional results show that gains from diversification depend on partners' bottlenecks versus a world average. While diversification proves effective in a "business as usual" period, it does not yield substantial benefits during a global shock.

[6]As is standard in the GVC literature, the solution involves using a Leontieff inverse matrix based on bilateral influence weights (de Soyres et al., 2023).
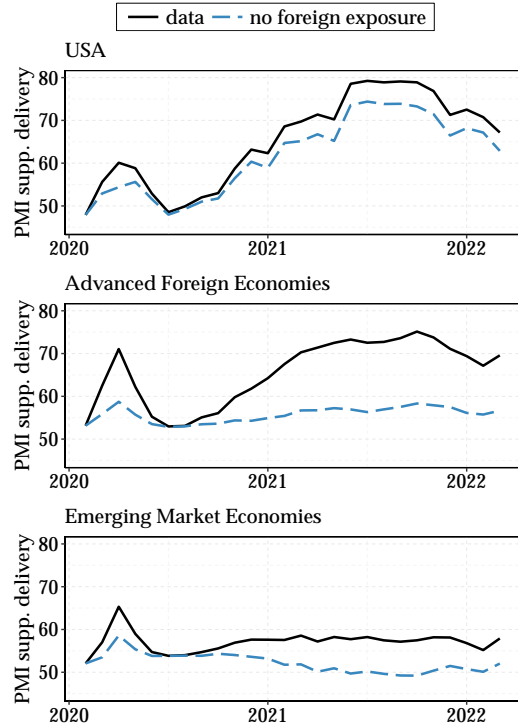

Fig. 2. Bottlenecks and Foreign Exposure

Overall, our results suggest that, while domestic bottlenecks during the pandemic were initially triggered by government-imposed mobility restrictions, they appeared to be amplified and made more persistent in countries with (i) large fiscal support and (ii) larger exposure to foreign bottlenecks through GVC linkages. These results highlight the importance of demand factors coupled with supply disruptions, both domestically and internationally propagated through GVCs.

II. Bottlenecks and Inflation

We now investigate the association between inflation and the presence of bottlenecks. In a sample of 21 countries from March 2014 to October 2023, we start by constructing separate 12-months inflation series for headline, core goods and core service inflation (Figure 3). Doing so allows us to separately investigate changes in patterns of sectoral consumption spending.[7]

[7]To construct country-specific series for goods and service inflation, we use each country's itemized CPI breakdown and corresponding weights to construct core goods and services aggregates, in line with the standards used by the ISIC whenever possible.
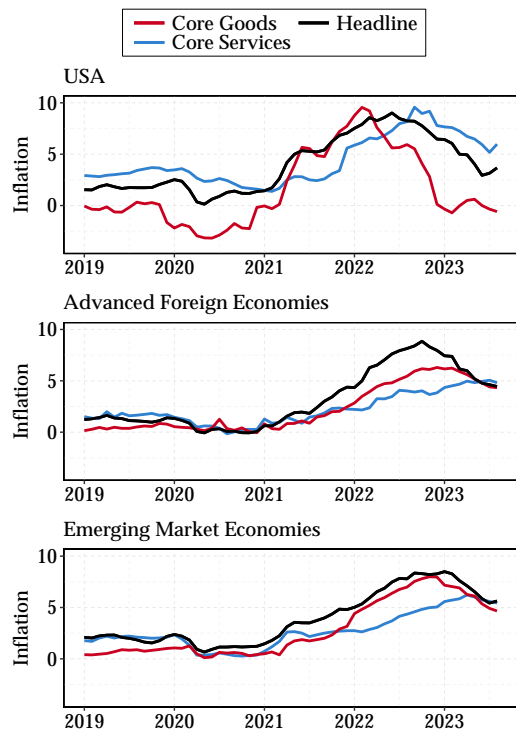
FIG. 3. INFLATION

ECONOMETRIC MODEL AND RESULTS

To quantify the role of bottlenecks on inflation, we use a variation of a model of inflation introduced by then-Federal Reserve Chair Janet Yellen in 2015, extended to a multi-country sample.[8] For each series $s \in \{$ Headline, Core, Core Goods, Core Services $\}$, we estimate the following equation:[9]

$$(3) \quad \text{Inflation}_{ct}^s = \sum_{k=0}^{2} \beta_{Lag\_k}^B \cdot \text{Bottlenecks}_{ct}$$
$$+ \beta_2 \cdot \text{Unemployment}_{ct}$$
$$+ \sum_{k=1}^{2} \beta_{Lag\_k}^I \cdot \text{Inflation}_{ct-k}^s$$
$$+ \text{controls} + \varepsilon_{ct}$$

[8] A related approach, focused on the US, has been used by the Council of Economic Advisor in a November 2023 blog post arguing that supply chains disruptions explain most of the excess core inflation from 2021-23. See more at: `https://shorturl.at/qHMVX`.

[9] Unlike the original Yellen specification, we do not include a term for expected inflation due to data limitations in most countries. Note that the explanatory power of expected inflation in the US case is very small.

As expected, our results show that inflation is negatively associated with unemployment and positively with lagged inflation. More interestingly, we find that bottlenecks have a positive and statistically significant effect on core goods inflation, while it is not associated with core services. Consistent with the literature on the frequency of firm-level price changes, we find that bottlenecks impact inflation with a 2-months lag, which is on the lower end of price change frequency and is in line with previous findings that firm adapt their price more frequently in periods of high inflation.
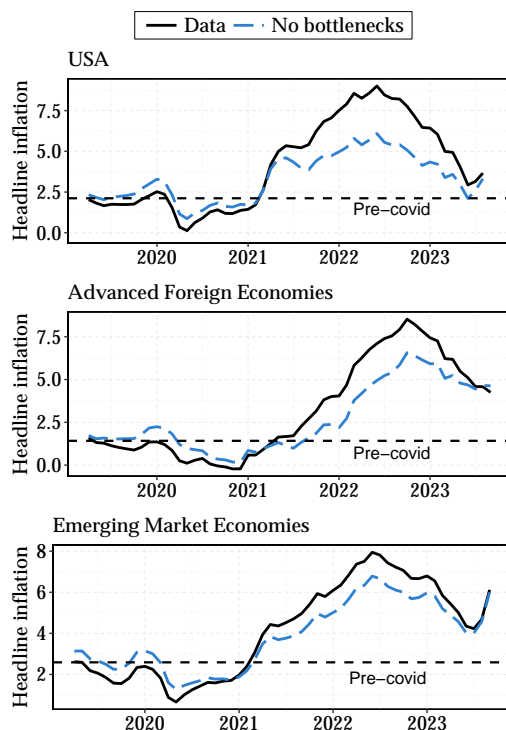

FIG. 4. INFLATION AND BOTTLENECKS

Based on our point estimates, Figure 4 presents a headline inflation series net of bottlenecks, revealing an outsized role of bottlenecks in the US, where the Russian invasion of Ukraine had muted effects. Defining excess inflation as the difference between inflation and each country's pre-pandemic average, our results suggest that at its peak, bottlenecks were associated with one-half of excess inflation in the US, approximately one-third in AFEs, and about one-fourth in EMEs. Focusing on the pre-Ukraine war period, we note that bottlenecks accounted for as much as half of the

excess inflation in AFEs in January 2022, suggesting that the 2022 energy shock was likely a significant factor in most European countries' inflation after the Russian invasion. Alongside this shock, other factors played a role in influencing inflation during this period. Our specification recognizes the importance of slack, as captured by unemployment rates. Additional elements to be studied further include expectations and import prices.

In summary, our findings highlight the important role of fiscal support in the Covid-related inflation surge by influencing bottleneck persistence. Although bottlenecks show no correlation with core services inflation, supplementary insights from de Soyres, Moore and Ortiz (2023) indicate that fiscal support is linked to the accumulation of household excess savings, contributing to the delayed increase in services inflation.

III. Final Remarks

The empirical associations identified in the paper highlight the importance of explicitly modeling fiscal shocks, capacity constraints, and input-output linkages through GVCs. Our findings emphasize the impact of fiscal support on the persistence of bottlenecks, the correlation between domestic bottlenecks and exposure to foreign disruptions, and the association between bottlenecks and core goods inflation, especially in advanced economies. All these findings can provide guidance for structural work.

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