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Quantifying the Inflationary Impact of Fiscal Stimulus under Supply Constraints†

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US headline inflation has hit levels not seen for several decades, reaching 9 percent per annum at its peak in June 2022 before declining to approximately 7 percent per annum by the end of 2022. In contrast, inflation was below 2 percent before the 2020 COVID-19 pandemic.

A priority that has been at the top of the minds of policymakers and academics alike has been to quantify the relative importance of the key factors in driving the observed inflation, particularly the relative importance of supply bottlenecks versus consumer demand, as the United States and world economies struggled with supply-demand imbalances arising from the COVID-19 health shock combined with stimulative policies.

The literature thus far has found differing results, ranging from one-third to two-thirds contributions from supply factors (with the remaining being demand). Shapiro (2022a, b) takes an econometric approach, while di Giovanni et al. (2022) and Ferrante, Graves, and Iacoviello (2023) use quantiative models.

Though these papers provide important early evidence on the different channels that drove the surge in inflation, none of them take a stand on the inflationary impact of specific policy actions. In particular, the 2021 Biden fiscal package totaled 15 percent of GDP and has been blamed by some for today's high inflation (Blanchard, Domash, and Summers 2022).

In this paper, we explicitly measure the impact of the fiscal stimulus on inflation over the December 2019 to June 2022 period. We follow our previous work and use the framework developed in Baqaee and Farhi (2022) in order to quantify the impact of different shocks on inflation. Importantly, unlike in our previous quantification exercises, we now feed aggregate demand shocks into the model that vary depending on whether the fiscal impulse is included or not. Doing so allows us to quantify the impact of aggregate demand in driving inflation and run a counterfactual scenario that omits observed government spending as part of the aggregate demand shock. This second scenario allows us to gauge the importance of the fiscal package's impact on inflation.

Our baseline results show that over the December 2019–June 2022 period, aggregate demand shocks explained roughly two-thirds of total model-based inflation in the United States, and that the fiscal stimulus contributed half or more of the total aggregate demand effect. The range for the impact of fiscal stimulus varies depending on how we detrend the data in constructing the empirical shock series. Since the fiscal packages came in a discrete fashion as bursts of government spending, such sensitivity is expected.

Section I presents a brief description of the model. Section II describes the data and methodology we use to construct the shocks that we feed into the model. Section III presents the main results.

I. Model

We build on previous work (di Giovanni et al. 2022) to quantify the sources of inflation using a multisector macro-network model in the spirit of Baqaee and Farhi (2022).

Intertemporal Allocation.—There are two periods: the first period corresponds to the

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pandemic, and the second one represents the postpandemic (i.e., the future). We denote the future quantities with an asterisk (*) in the subscript. There are two types of consumers. Ricardian consumers optimize their budget across two periods to smooth out their consumption such that their intertemporal consumption decisions optimize

$$C^{\beta} C_*^{1-\beta},$$

where C is the consumption and β captures the Ricardian consumers' time preferences. We assume that we are at the zero lower bound for the interest rate. Hence, household spending and income (I) are related to each other:

$$I + I_* = pC + P_* C_*.$$

Hand-to-mouth consumers, on the other hand, cannot borrow against their future income (I_*) and spend only their current income. The share of Ricardian consumers is denoted by ϕ.

Within-Period Consumption.—We assume that there are N sectors. Within each period, the consumers allocate their budgets across the sectors with a Cobb-Douglas utility:

$$(1) \qquad \ln C = \sum_{i=1}^{N} \alpha_i \delta_i \ln c_i,$$

where c_i is the consumption in sector i, α_i is the consumption share during the non-COVID period such that $\sum_{i=1}^{N} \alpha_i = 1$, and δ_i is the shift in sectoral consumption during the pandemic such that $\sum_{i=1}^{N} \alpha_i \delta_i = 1$.

Production.—Each sector i uses the intermediate inputs from other sectors (input from sector j to sector i is denoted by x_{ij}), sector-specific labor (L_i) and sector-specific capital K_i. The output of sector i (y_i) is given by

$$(2) \quad y_i = \left[\left(\omega_{iL} L_i^{\frac{\gamma-1}{\gamma}} + \omega_{iK} K_i^{\frac{\gamma-1}{\gamma}} \right)^{\frac{\gamma}{\gamma-1} \frac{\theta-1}{\theta}} + \left(\sum_{j=1}^{N} \omega_{ij} x_{ij}^{\frac{\varepsilon-1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon-1} \frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}},$$

where ω_{iL} (ω_{iK}) determines the labor (capital) share and ω_{ij} captures the intermediate input shares. ε dictates the interindustry substitution between inputs, γ controls the substitution between labor and capital, and θ determines the substitution between the factors and input bundle.

Equilibrium.—For normalization purposes, we take $p_* = 1$ and $C_* = 1$. The equilibrium is achieved through adjustment of prices, wages, and rental rents of capital such that good markets clear $(y_i = c_i + \sum_{j=1}^{n} x_{ji})$, capital markets clear $(K_i = K_{i*})$, producers maximize their profits, and consumers optimize their consumption.

For labor, during the pandemic, some workers are unable to work due to COVID-related reasons. Let's denote the prepandemic (postpandemic) level of labor in industry i with L_{i*}. During the pandemic, the number of available workers in industry i shrinks to $\bar{L}_i \leq L_{i*}$. Moreover, the workers will not accept a wage below their prepandemic levels. Denoting the wage of workers in industry i with w_i, the wage levels satisfy $w_i \geq w_{i*}$; that is, wages do not go below their equilibrium levels absent the pandemic.

II. Data

A. *Detrending Methods*

We implement two detrending procedures to estimate the shocks that the model requires. The model needs sectoral demand and supply shocks and an aggregate demand shock. In the first procedure, for sectoral shocks at monthly frequency, we compute the average annual growth rate between 2015 and 2019 for sectoral total hours worked and sectoral consumption expenditure for each of the 66 sectors separately. For quarterly nominal GDP, we do the same for the period 2010–2019. Then, for each sector, for consumption and labor, and for aggregate nominal GDP, we take the deviations from these constant average growth rates during our analysis period to get at our shocks.

The second procedure estimates the following linear regression for each time series Y_t, at the sector or at the aggregate level:

$$\ln Y_t = \beta_0 + \beta_1 t + \varepsilon_t,$$

where β_0 and β_1 are estimated parameters, t is a linear trend, and ε_t is an error term. We then compute the trend variable as

$$\hat{Y}_t = \hat{\beta}_0 + \hat{\beta}_1 t.$$

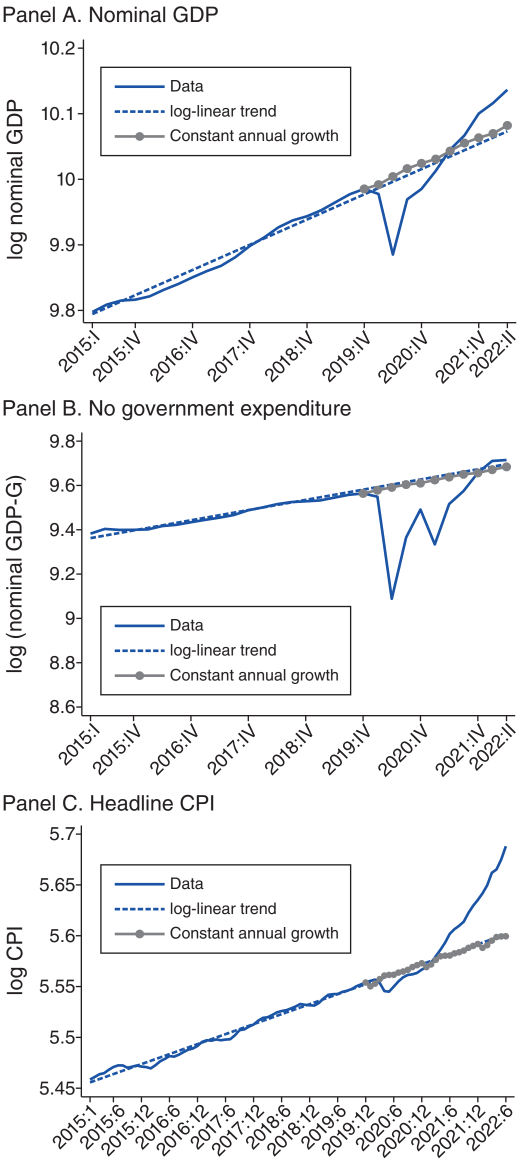

FIGURE 1. AGGREGATE DATA TIME SERIES

Note: This figure shows the (log) levels of each series (solid lines) together with the annual constant growth rate series (gray dotted line) and a (log) linear trend (dashed lines).

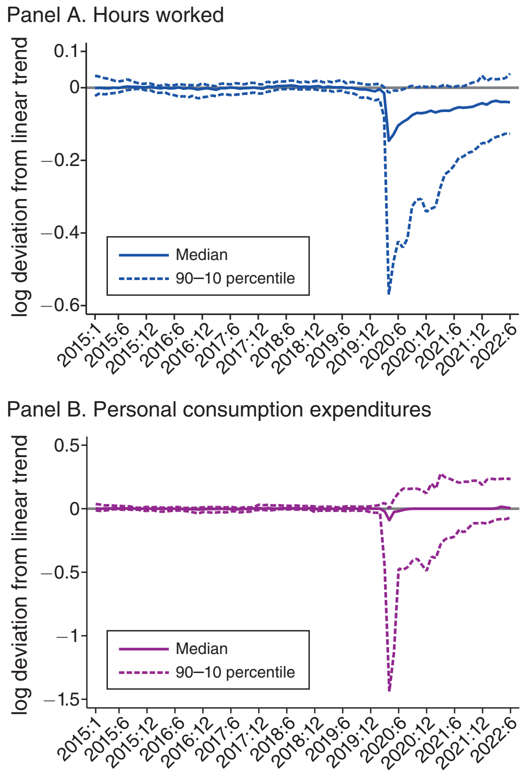

FIGURE 2. SECTORAL DATA TIME SERIES

Notes: This figure shows the cross-sectional median (solid line) and the 90–10 percentiles (dashed lines) across 66 sectors at each point in time. Panel A plots total hours worked, while panel B plots personal consumption expenditures.

The shocks we feed in are then the residuals:

$$shock_t \; = \; \ln Y_t - \ln \hat{Y}_t.$$

To get a sense of what these detrending procedures look like in practice, Figure 1 plots these trends for three aggregate time series together with actual data. Panels A and B plot the aggregate demand shock, nominal GDP, and nominal GDP without government expenditure, respectively, while panel C plots headline inflation. The solid blue lines denote the raw data, the gray dotted lines denote the constant annual growth trend, and the blue dashed lines denote the log-linear trend. As can be seen, both methods deliver similar patterns for the three aggregate time series. For the detrending of the sector-level data, Figure 2 presents cross-sector differences. Panel A plots total hours worked (used for the sectoral supply shocks), while panel B plots personal consumption expenditures (used for the sectoral demand shocks). The figure shows the cross-sectional median (solid line) and the 90–10 percentiles (dashed lines) across 66 sectors at each point in time.

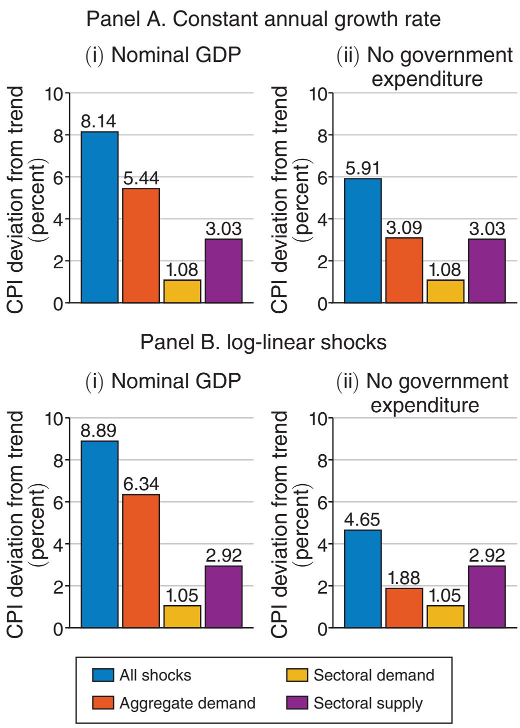

Figure 3. CPI Deviation from Trend in June 2022 without Hand-to-Mouth Consumers

Notes: All subfigures compute shocks as deviation from trend in June 2022. Panel A uses a constant annual average growth rate starting in 2020:I to construct trend series. Panel B uses a log-linear trend. We compute shocks to each series as log-deviations from these trends respectively. Panels A(i) and B(i) feed in nominal GDP as an aggregate demand shock, while panels A(ii) and B(ii) feed in nominal GDP minus total government expenditure as the aggregate demand shock. The observed headline CPI inflation between December 2019 and June 2022 was 14.35.

III. Results

Figure 3 presents the main results. Since we feed into the model shocks as deviations from trends, the model-predicted inflation is also a deviation from trend and hence should be compared to the June 2022 consumer price index's (CPI's) deviation from trend in the data.

Panel A presents results based on the constant-growth detrending method, while panel B presents results based on shocks derived from log-linear detrending. The percentage change in the price level given by the CPI from December 2019 to June 2022 was 14.35 percent. The model predicts something close to this number: 13.17 percent under constant-growth detrending and 14.18 percent under log-linear detrending.[1] Panels A(i) and B(i) use nominal GDP as an aggregate demand shock measure, while in panels A(ii) and B(ii), we subtract total government expenditure from nominal GDP. Sectoral demand and supply shocks are as described above.

As expected, the model delivers higher inflation when feeding in nominal GDP as an aggregate demand shock relative to the exercise that excludes government expenditure. The aggregate demand shocks (orange bars) generate by themselves roughly two-thirds of the total model-based inflation (blue bars) in panels A(i) and B(i). Removing government expenditures in panels A(ii) and B(ii) drops the contribution of aggregate demand shocks considerably. Regardless of the detrending method, aggregate demand explains two-thirds of the model-based inflation when we include government stimulus. When we exclude government expenditure from nominal GDP, aggregate demand explains at most half of the model-based inflation, while sectoral supply shocks and sectoral demand shocks explain the rest (purple and yellow bars, respectively). These latter shocks contribute nontrivially to aggregate inflation; importantly, their absolute magnitude is not affected when government expenditure is dropped from the aggregate shock.

These results assume that all households are Ricardian—that is, $\phi = 1$. Figure 4 presents results when we allow 30 percent ($\phi = 0.7$) of the population to be hand-to-mouth consumers. Results are similar to the Ricardian model, except now predicted inflation is lower. Why is this? Remember that the model allows for the possibility of unemployment. When consumers are Ricardian and become temporarily unemployed, their consumption is unaffected, as they can substitute future consumption for current consumption. In contrast, when hand-to-mouth consumers become temporarily unemployed, they reduce their demand for goods in the

[1] Our model gives results as deviations from trend. To compare these results to actual inflation, we add the trend under each detrending method to the model's results, the numbers in the blue bar of panels A(i) and B(i) in Figure 3, respectively. The trend was 4.65 percent with constant-growth detrending and 4.86 under log-linear detrending.

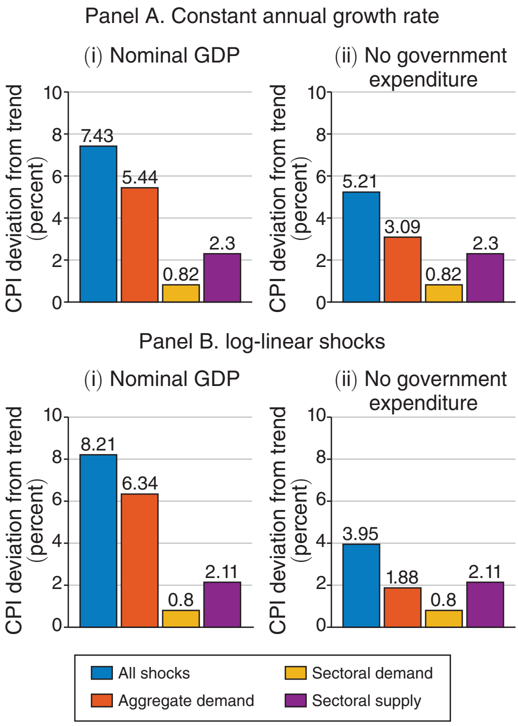

Figure 4. CPI Deviation from Trend in June 2022 with Hand-to-Mouth Consumers

Notes: All subfigures compute shocks as deviation from trend in June 2022. Panel A uses a constant annual average growth rate starting in 2020:I to construct trend series. Panel B uses a log-linear trend. We compute shocks to each series as log-deviations from these trends respectively. Panels A(i) and B(i) feed in nominal GDP as an aggregate demand shock, while panels A(ii) and B(ii) feed in nominal GDP minus total government expenditure as the aggregate demand shock. The observed headline CPI inflation between December 2019 and June 2022 was 14.35. We set the hand-to-mouth share in these experiments at 0.3.

economy, as they have no income and no possibility of borrowing. As a result, any shock that causes unemployment now has a lower effect on prices, as hand-to-mouth consumers lose their income, pushing demand down as well as, given supply, prices. This mechanism is precisely what Figure 4 shows: both sectoral demand and sectoral supply shocks have lower inflationary effects in the hand-to-mouth scenario relative to the Ricardian scenario. Aggregate demand, in contrast, exhibits the same magnitudes as before. Recall that in the model, an aggregate demand shock works through intertemporal substitution: consumers substitute away from future consumption toward current consumption for given prices and income. Since all good and factor prices are flexible upward, an increase in aggregate demand maps one-to-one to increases in good prices, ultimately resulting in inflation. However, the sectoral demand and supply shocks will impact inflation via the hand-to-mouth consumer constraint, as these shocks will create some unemployment. This can seen by the different impact of these shocks in the right two bars of Figure 4 compared to their impact in the Ricardian model of Figure 3.

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