## Fiscal Influences on Inflation in OECD Countries, 2020-2023

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# **COVID** Inflation and Fiscal Dominance

- COVID crisis 2020-2023: surge of inflation along with surge in fiscal deficits in many countries made economists receptive to idea that fiscal factors key to recent inflation.
- By inflating away real value of debt, inflation—unanticipated as of 2019—is a substantial source of effective real government revenue: akin to partial debt default.
- Analyze conceptually in context of government intertemporal budget constraint. Focus on frictionless version of model, no nominal rigidities.
- Apply empirically to 37 OECD countries, 2020-23.

# **Budget Equation**

Market value of govt debt as present discounted value of future primary surpluses

$$\frac{B_t}{P_t} = \sum_{i=1}^{\infty} \frac{\left(\mathcal{T}_{t+i} - G_{t+i}\right)}{\left(1+r\right)^i}$$

- *B<sub>t</sub>*: Nominal market value of short- and long-term public debt at the start of period *t*.
- *P<sub>t</sub>*: Price level at the start of period *t*.
- $T_t$ ,  $G_t$ : Real taxes and real primary spending in period t.
- r: Constant real interest rate.
- Assumes no-Ponzi condition for long-term financing.
- Stock of real government bonds equals the present value of real primary surpluses.

# Spending Surge

- A crisis (pandemic or war), leads to unexpected surge in  $G_{t+i}$ , i = 0, ..., M.
- Temporary surge: spending returns to pre-crisis levels after M periods
- Assume growth and real interest rates approximately equal and stable:

$$Y_t \cdot \left[\Delta\left(\frac{G_t}{Y_t}\right) + \Delta\left(\frac{G_{t+1}}{Y_{t+1}}\right) + \dots + \Delta\left(\frac{G_{t+M}}{Y_{t+M}}\right)\right]$$

(1)

### **Government Bonds**

- Assume total of coupon and principal payments rise over time with expected path of nominal GDP. Otherwise, amounts uniform out to maximum debt maturity, *T*.
- Reaction to surge in spending assumed to be surge in inflation rates,  $\pi_{t+1} \dots \pi_{t+T}$ , above target,  $\pi^*$  for **T** periods, with  $\pi^*$  assumed fixed.
- Shifts in inflation rates appear in long-term nominal interest rates ⇒ Market value of debt drops.
- Monetary authority accommodates path of inflation dictated by fiscal considerations. We do not detail this process. Fiscal & monetary authorities cooperate.

# Change in Value of Public Debt

 Change in market value of debt generated by shift in (actual and expected) inflation rates from π<sup>\*</sup> to sequence π<sub>t+1</sub>... π<sub>t+T</sub> given by:

$$\Delta B = \frac{B_t^*}{1+T} \left\{ \left[ \frac{(1+\pi^*)}{(1+\pi_{t+1})} - 1 \right] + \left[ \frac{(1+\pi^*)^2}{(1+\pi_{t+1})(1+\pi_{t+2})} - 1 \right] + \dots + \left[ \frac{(1+\pi^*)^T}{(1+\pi_{t+1})\dots(1+\pi_{t+T})} - 1 \right] \right\}$$

- $B_t^*$  is the value of outstanding public debt. A boost to inflation rates,  $\pi_{t+i} > \pi^*$ , implies a negative  $\Delta B$ .
- As stressed by Cochrane, multiplicity of future inflation rates correspond to given △B.
   If debt maturity, *T*, long, part of inflation surge can occur in distant future.
- May be optimal to smooth out boost to inflation rates.

# Debt devaluation and inflation

• If higher inflation rate,  $\pi_{t+i}$ , is constant at  $\pi > \pi^*$  for *T* periods, result is:

$$\Delta B \approx -B_t^* \cdot \frac{1}{2}T \cdot (\pi - \pi^*)$$

- Negative value of  $\Delta B$  corresponds to a boost in the inflation rate,  $\pi > \pi^*$ .
- Given  $\Delta B$ , larger  $B_t^*$  (initial debt) or  $\frac{T}{2}$  (debt duration)  $\Rightarrow$  smaller  $\pi \pi^*$ .

# A parsimonious expression for inflation

 We obtain a simple relation between change in inflation and COVID fiscal stimulus rescaled for amount and duration of outstanding government debt

$$\pi - \pi^* = \eta \left( \sum_{i=1}^{M} \Delta \frac{\mathbf{G}_{t+i}}{\mathbf{Y}_{t+i}} \right) / \left( \frac{B_t^*}{P_t Y_t} \frac{T}{2} \right)$$

• Verify whether relation can explain cross-country variation in inflation

$$\pi_{it} = \pi_i^* + \eta \cdot (\Delta G)_{it} + X_t + \beta Z_{it} + u_{it}$$

where  $\pi_i^*$  is a country-specific fixed effect,  $X_t$  is year fixed effect to capture the effects of the pandemic,  $Z_{it}$  is a border with Ukraine or Russia dummy.

## State-Contigent Public Finance

- $\eta = 0$  when surge in spending matched by expectations of future fiscal adjustments. corresponds to standard intertemporal public finance, holds in most circumstances
- $\eta > 0$  applies only during economic emergencies, such as COVID crisis or large war.
- Discussion fits with state-contingent fiscal-deficit policies of Lucas/Stokey (1983) in context of wartime, notably WWII.
- Upshot is fiscal deficits and inflation not much related during "normal" economic times but could be closely connected during unusual events, such as COVID crisis.

## Ukraine-Russia War

- Model says inflation rate reacts to composite government-spending variable, which equals cumulative surge in ratios of government spending to GDP divided by initial debt-GDP ratio and average debt maturity.
- Empirical application allows for additional effect from Ukraine-Russia War (started 2022). Countries that share common border with Ukraine or Russia found to have higher inflation rates than would otherwise be predicted.

### Data

#### Duration of public debt

 Data from OECD on "average remaining maturity" of general govt gross public debt (also BIS). Refers to principal payments, not coupons. Approximation to calculate duration of debt, using formula that factors in stated maturity along with current and lagged nominal interest rates on government bonds.

#### 2 Euro-area data

• Weighted averages of 17 countries with Euro area viewed as single economy.

#### Proximity to war in Ukraine

 Assembled information related to distances and trade shares. Empirically, results best with simple dummy variable for whether country shares common border with Ukraine or Russia (8 OECD countries).

# Identification

- Assume composite govt-spending variable exogenous with respect to inflation.
- Spending variable relates negligibly to extent of economic downturn gauged by real GDP growth 2019-2020.
- Identification comes from cross-sectional variation across OECD countries.
- Country-fixed effect controls for average/target inflation in each country
- Time-fixed effect controls for impact of the pandemic and other global shocks

# **Empirical Setup**

- Sample comprises 37 OECD countries (all except Turkey), 20 outside Euro, 17 Euro.
- Main setting treats Euro zone as single economy.
- For 21 economy sample, means of  $\frac{G_{(t+i)}}{Y_{(t+i)}}$  are .360 in 2019, .414 in 2020, .391in 2021, .364 in 2022, .370 in 2023.
- Pattern suggests rise in spending ratios may be temporary; after 2 years (corresponding to M), spending ratios back to pre-crisis levels from 2019.
- → Measure spending surge as cumulative increase in primary spending ratios for 2020-2021, relative to 2019, divided by debt to GDP and duration of debt in 2019.
- Inflation measured as 1-year change in price index.

### Baseline regression - Euro zone treated as one economy

		Headline CPI inflation rate		Core CPI inflation rate	
Coefficients of Composite Government Spending	2020	0.472** (.189)		0.507*** (.150)	
	2021	0.533*** (.189)		0.804*** (.150)	
	2022	1.156*** (.191)		1.320*** (.152)	
	2023	0.969*** (.191)		0.737*** (.152)	
	2020 - 2023		0.777*** (.109)		0.838*** (.088)
	p-value equal coefficients	0.018		0.001	
	2022	0.028*** (.008)		0.009 (.007)	
Coefficients of	2023	0.047*** (.008)		0.037*** (.007)	
Dummy	2022 - 2023		0.040*** (.006)		0.025*** (.005)
	p-value equal coefficients	0.098		0.002	
Statistics, Number of Obs. = 294	R-squared	0.80	0.79	0.80	0.78
	s.e. of regression	0.013	0.013	0.010	0.011
	p-value 6 equal coefficients	0.015		0.0001	

Regressions by panel OLS, s.e.'s in parentheses. Each regression includes country and year fixed effects. \*\*\*p<0.01, \*\*p<0.05, \*p<0.1

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### Key takeaways

- Hump shape in the inflation response, coefficients statistically significant and positive
- Estimated coefficients of govt-spending variable average to around 0.8.
- Ukraine-Russia border dummy positive, significant, raises *R*<sup>2</sup> and does not significantly affect coefficients of govt-spending.
- Around 80% of spending surge financed by unanticipated inflation, rest by standard public finance.
- Estimated coefficient not statistically different from 1.

# Headline CPI inflation versus composite govt-spending variable



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## Core CPI inflation rate versus composite govt-spending variable



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# Inflation versus Govt Spending

- Figures depict the relationship between the change in CPI inflation rate (headline & core) and the govt-spending variable. Effects of border dummy filtered out.
- U.S. not an outlier. Lies moderately above average for the govt-spending variable (0.029 vs. 0.024) and close to average for changes in inflation rates.
- Euro area below U.S. for inflation and govt-spending variable.
- Clear positive slopes that do not seem to be driven by extreme observations.

## **Components of Govt-Spending Variable**

- Assess how statistical significance of composite government-spending variable relates to 3 components:  $\Delta(G/Y)$ , debt-GDP ratio, debt duration.
  - Each component set, one at a time, at sample mean → Designated variable restricted not to contribute to explanation of cross-sectional variations in inflation.
  - Constraint amounts to one coefficient restriction imposed on estimation: Test validity of restriction using -2\*log(likelihood ratio) distributed asymptotically as Chi-squared variable with one degree of freedom.
  - Restricted model always strongly rejected for headline and core inflation.
- Can also use linear approximation to express right side as 3 separate terms: values relative to sample means of spending surge, initial debt-GDP ratio, initial duration.
  - Get three separate coeffs, pattern: +, -, -.
  - Accept hypothesis that coeffs equal size with this sign pattern.

# Including only Fiscal Surge

- Positive connection between change in inflation rate and incremental government spending, Δ<sup>G</sup>/<sub>Y</sub>, not surprising from Keynesian perspective.
- Distinguishing feature of present model is two scaling variables—initial values of debt-GDP ratio and debt duration.
- In particular, effect of debt-GDP ratio on boost to inflation negative for given Δ<sup>G</sup>/<sub>Y</sub>, whereas aggregate-demand model might generate opposite sign.
- If fiscal variable enters just as Δ<sup>G</sup>/<sub>Y</sub>, estimated coefficients positive, but only marginally significant and fit much poorer.

#### Change in headline CPI inflation rate versus excess govt spending



#### **Fiscal Influences on Inflation in OECD Countries**

### Change in core CPI inflation rate versus excess govt spending



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### Euro-zone countries entered separately

- First G-variable same as baseline; Euro countries have Euro-area weighted average. Second G-variable for Euro zone is individual G relative to Euro-area average.
- Coefficient on second variable does not differ significantly from zero for core inflation, marginally significant for headline.
- Main conclusion is aggregating Euro-zone countries into one economy satisfactory for analyzing effects of G variable on inflation rates.
- Does not mean that Euro zone is a "fiscal area."

# Regressions for Change in Inflation - EA countries

	Headline CPI inflation rate	Core CPI inflation rate
Excess govt spending/(gross debt)*duration Table 1	0.737***	0.810***
	(0.104)	(0.080)
Excess govt spending/(gross debt)*duration: Euro area	0.143**	0.071
	(0.065)	(0.050)
Border with Ukraine/Russia	0.0457***	0.0283***
	(0.0041)	(0.0031)
Number of Observations	518	518
R-squared	0.823	0.805
s.e. of regression	0.0129	0.0099
log(likelihood)	1548	1684

Regressions by panel OLS, s.e.'s in parentheses. Each regression includes country and year fixed effects.  $^{***}p{<}0.01,\ ^{**}p{<}0.05,\ ^{*}p{<}0.1$ 

# **Additional Results**

- Prediction that length of high inflation equal to duration of public debt. For U.S., this is 5 years, starting 2020. Higher duration for UK (10-12 years), Euro area (7).
- Next figure shows evolution of ratios of gross public debt to GDP—U.S. and GDP-weighted average for 21 economies.
- Surge in 2020 with fiscal deficits. Down since—effects of rising nominal GDP and decline in market value of debt because of rising nominal interest rates.

## Ratio of Gross Public Debt to GDP



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# Conclusions

We examine the relationship between fiscal stimulus and post-pandemic inflation

- We find strong and positive relation between inflation and the increase in spending rescaled by maturity and size of outstanding debt
- We control for global effects of the pandemic via a time fixed effect
- All components of the composite spending variable matter. Relation weaker when one of the components is excluded by the analysis.

#### **Current Research**

- Adding 9 non-OECD countries with data: Brazil, Croatia, India, Indonesia, Malaysia, Peru, Singapore, South Africa, Thailand.
- Will apply to U.S. states. Analogous to Euro zone?
- Policy implications: was it mistake to have inflation surge, contingent on paths of government spending?

#### Table 6

	Headline CPI Inflation Rate			Core CPI Inflation Rate		
	(1)	(2)	(3)	(4)	(5)	(6)
Variable Set at Sample Mean:	Govt Spending	Gross Debt	Duration	Govt Spending	Gross Debt	Duration
Composite Government Spending	0.415***	0.487***	0.722***	0.498***	0.537***	0.776***
	(0.146)	(0.128)	(0.125)	(0.124)	(0.108)	(0.104)
Border Dummy	0.0394***	0.0435***	0.0479***	0.0235***	0.0285***	0.0333***
	(0.0071)	(0.0067)	(0.0065)	(0.0060)	(0.0057)	(0.0054)
Number of Observations	294	294	294	294	294	294
R-squared	0.761	0.766	0.781	0.724	0.732	0.759
s.e. of Regression	0.0142	0.0140	0.0136	0.0120	0.0119	0.0113
log(Likelihood)	853.151	856.684	866.552	901.164	905.687	921.138
p-value	0.000	0.000	0.000	0.000	0.000	0.000
Relative Likelihood (AIC)	0.000	0.000	0.000	0.000	0.000	0.000

Regressions by panel OLS, s.e.'s in parentheses. Each regression includes country and year fixed effects. \*\*\*p<0.01, \*\*p<0.05, \*p<0.1

#### Table 7

	Headline CPI inflation rate	Core CPI inflation rate
$\left( {old G} - \overline{old G}  ight) \cdot \overline{\Omega} / \overline{old G}$	0.749***	0.825***
	(0.169)	(0.141)
$\left( oldsymbol{B} - \overline{oldsymbol{B}}  ight) \cdot \overline{\Omega} / \overline{oldsymbol{B}}$	-0.520***	-0.554***
	(0.144)	(0.120)
$\left( D - \overline{D}  ight) \cdot \overline{\Omega} / \overline{D}$	-0.721**	-0.781***
	(0.306)	(0.255)
Border with Ukraine/Russia	0.0412***	0.0262***
	(0.0069)	(0.0058)
Number of Observations	294	294
R-squared	0.776	0.750
s.e. of regression	0.0138	0.0115
p-value	0.406	0.166

# Table 5 - Alternative version - OLS with 21 economies

	Headline CPI inflation rate		Core CPI inflation rate	
	(1)	(2)	(3)	(4)
Constant	0.0079	0.0066	0.0005	-0.0004
	(0.0060)	(0.0049)	(0.0044)	(0.0039)
Excess govt spending/(gross debt)*duration	0.856***	0.758***	0.887***	0.822***
	(0.209)	(0.175)	(0.156)	(0.137)
Border with Ukraine or Russia		0.0251***		0.0166***
		(0.0079)		(0.0062)
Observations	21	21	21	21
R-squared	0.468	0.660	0.631	0.737
s.e. of regression	0.0151	0.0124	0.0112	0.0097