Fiscal deficits and inflation risks: the role of fiscal and monetary regimes*

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Abstract

Using data from a panel of advanced economies over four decades, we show that the inflationary effect of fiscal deficits crucially depends on the prevailing fiscal-monetary policy regime. Under fiscal dominance, defined as a regime in which the government does not adjust the primary balance to stabilise debt and the central bank is less independent or puts less emphasis on price stability, the average effect on inflation of higher deficits is found to be up to five times larger than under monetary dominance. Under fiscal dominance, higher deficits also increase the dispersion of possible future inflationary outcomes, especially the probability of high inflation. Based on forecasts from our model, the high inflation experienced by many countries during the recovery from the Covid-19 pandemic appears more consistent with a regime of fiscal dominance than monetary dominance.

JEL Codes: E31; E52; E62; E63.
Keywords: Fiscal deficit, inflation, fiscal policy regime, monetary policy regime, monetary policy independence.

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1 Introduction

Governments unleashed a massive wave of fiscal stimulus in the wake of the Covid-19 pandemic, pushing up government debt by around 15 percentage points of global GDP between 2019 and 2021. These developments have triggered a debate about the inflationary consequences of fiscal policies (eg Krugman (2021), Summers (2021)). The Economist (2021) has asked whether inflation is a fiscal phenomenon. And some commentators have even argued that the need to manage the high levels of public debt might result in fiscal dominance over monetary policy, posing a risk to price stability (eg Landau (2021)).

The theoretical literature has long considered the central role of fiscal policy for inflation. In their seminal paper, Sargent and Wallace (1981) demonstrated the impotence of monetary policy to control inflation when the government runs large fiscal deficits not ultimately financed by taxation. Leeper (1991) argued that the price level would adjust to re-establish the government's intertemporal budget constraint if fiscal policy is unsustainable.

We contribute to this literature by showing that in historical data, the fiscal deficit-inflation relationship crucially depends on the prevailing fiscal-monetary policy regime. To investigate the contribution of fiscal policy to inflation, we estimate an open economy Phillips curve augmented with the fiscal balance using data from 21 advanced economies over four decades.

What distinguishes our analysis from previous research is the careful consideration of the fiscal-monetary policy regime in place. To classify those regimes we use both *de facto* and *de jure* measures. As to the fiscal regimes, our *de facto* classification is based on the result from the seminal paper by Bohn (1998) which shows that fiscal policy satisfies the government's intertemporal budget constraint when the primary surplus is an increasing function of the level of debt relative to GDP. In our baseline specification we follow Mauro et al. (2015) who operationalise Bohn (1998) by estimating fiscal reaction functions in a panel of economies. The authors classify the regimes as either "prudent" or "profligate" depending on whether the estimated response of fiscal surpluses is increasing in the level of debt within a given window. We also consider *de jure* classifications of fiscal regimes based on whether the economy has in place a fiscal rule for the budget balance - that is, legal numerical limits on the overall balance, the structural or cyclically adjusted balance, or the balance over the cycle.

As to monetary policy regimes, we look at whether monetary policy acts to maintain price stability. Our *de jure* classification of monetary policy regimes is based on whether a central bank is classified as being highly or weakly independent. Cukierman (1992) and Cukierman et al. (1992) show that the degree of central bank independence is negatively correlated with inflation in advanced economies. The specific measures we use come from Romelli (2022) who follows the entire set of legislative changes to laws concerning the central bank. Given the particular importance of monetary accommodation of fiscal policy, our baseline *de jure* measure is based on specific limitations on central bank lending to the public sector enshrined in central bank laws. Our *de facto* measure of the monetary policy regime is based on whether the central bank's policy interest rate is below that suggested by a Taylor rule (Taylor (1993)). A number of studies have shown that failure to satisfy the Taylor principle, i.e. not adjusting interest rates by more than with inflation, resulted in inflation instability in the United States during the 1960s and 1970s (see for example Taylor (1999), Clarida et al. (2000) and Davig and Leeper (2007)).

Our results show that the regimes matter. Figure 1 shows that the estimated average effect of an increase in the overall fiscal deficit on inflation differs strongly across the four combinations of fiscal and monetary policy regimes that we consider. The lowest inflationary effect is found in regimes with a prudent fiscal authority that stabilises debt levels together with an independent central bank with strong legal limitations that prevent

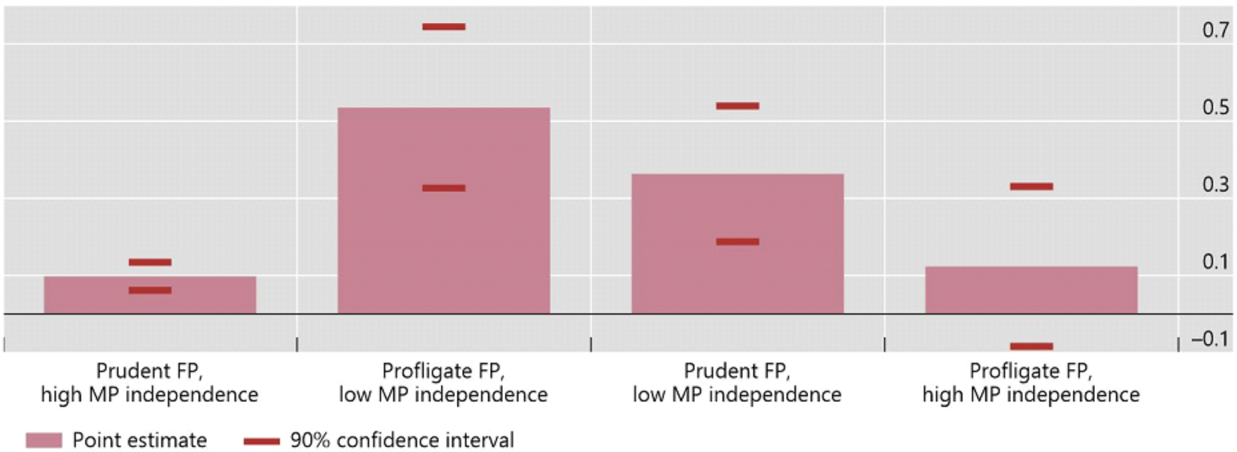

Figure 1: **The inflationary impact of fiscal stimulus across fiscal and monetary regimes**. The figure shows the estimated average impact of a one percentage point increase in the fiscal deficit on inflation over the next two years across different combinations of fiscal and monetary regimes. Fiscal regimes are classified as prudent or profligate based on Mauro et al. (2015). Monetary regimes are defined as being high or low independence based on legal limitations on central bank lending to the public sector in Romelli (2022).

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lending to the public sector. In this regime which we define as "monetary dominance", a one percentage point increase in the fiscal deficit results in a 10 basis point increase in the average inflation rate over the next two years.[1]

By contrast, the greatest inflationary effect is found in the regime which we define as "fiscal dominance", i.e. in which fiscal policy is profligate and the central bank faces limited constraints on lending to the public sector. Under fiscal dominance, a one percentage point increase in the overall deficit raises the inflation rate on average by around 50 basis points, over five times higher than in the monetary dominance regime.

The average inflationary effects of higher deficits in the other two regimes lie somewhere between the monetary dominance and fiscal dominance regimes. The effect of deficits in the prudent fiscal policy and low monetary independence regime is higher than in the profligate fiscal regime with high monetary policy independence (where the effect is, moreover, not statistically significant). This latter result is perhaps surprising. As shown in Sargent and

[1]There is no uniform definition of monetary and fiscal dominance in the literature, see e.g. the discussion in Jeanne (2012).

Wallace (1981) or Leeper (1991), any attempt by a central bank to control inflation when fiscal policy is non-Ricardian leads to explosive inflationary dynamics. However, unlike in many theoretical models, the regimes in our empirical analysis are not fixed or permanent.

Beyond analysing the average effect, we further examine how fiscal and monetary policy regimes affect inflation risks across the entire inflation forecast distribution using the inflation-at-risk methodology developed for panels in Banerjee et al. (2020). We find significant non-linearities with particularly large upside inflation risks following an increase in fiscal deficits. The upside inflation risks, as well as the overall variance of inflation, are considerably higher in the fiscal dominance regime compared to a monetary dominance regime.

The differences in inflation behaviour in the fiscal and monetary dominance regimes go beyond the relationship between deficits and inflation. In the fiscal dominance regime, the average sensitivity of inflation to output growth is around three times larger than in the monetary dominance regime. The sensitivity is even higher in the upper tails of the inflation distribution.

Finally, we use our model to shed light on the seemingly unexpected burst of inflation across advanced economies following the Covid-19 pandemic. The large fiscal and monetary policy stimulus that took place in 2020 may have occurred against the backdrop of laxer fiscal and monetary policy regimes, which are more tolerant of higher and rising public debt and positive deviations of inflation from target, respectively. Given the size of the fiscal stimulus and other macroeconomic variables observed in 2020, forecasts from our model suggest that the high inflation outcomes in 2021 and 2022 appear more consistent with a regime of fiscal rather than monetary dominance.

Our paper is related to several streams of research. It adds to the literature examining how inflation depends on the interactions and policy priorities of fiscal and monetary policy makers (eg Sargent and Wallace (1981), Leeper (1991), Leeper et al. (2017)). For the United

States, Bianchi and Ilut (2017) show that monetary policy accommodation of fiscal policy during the 1960s and 1970s was an important driver of high inflation. Moreover, they find that tight monetary policy on its own was not sufficient to stabilise inflation, noting that inflation in the United States dropped only when agents' beliefs changed about the government's desire to stabilise debt. Bianchi and Melosi (2022) and Bianchi et al. (2022) show that movements in trend inflation in the United States can be accounted for by fiscal shocks and changes in the fiscal-monetary policy mix. We contribute to this literature by empirically classifying the different fiscal and monetary policy regimes and then examining how their interaction has influenced inflation rates in historical cross-country data.

Similarly underscoring the importance of policy interaction, the recent literature on fiscal multipliers shows that the strength of the macroeconomic effects of fiscal policy crucially depends on how a fiscal expansion is financed and how monetary policy responds (see eg Woodford (2011), Erceg and Lindé (2014), Ramey (2019), Ascari et al. (2022)). Relative to this literature, we examine how the fiscal and monetary regimes influence the effects of larger fiscal deficits.

Our paper is also related to earlier research by Catao and Terrones (2005) who find a significant link between persistent fiscal deficits and inflation among developing and emerging market economies but a weak or an insignificant relationship for advanced economies. In contrast to this study, we focus on the short-term inflationary impact and on its crucial dependence on the fiscal-monetary policy regime.

Finally, our paper is related to López-Salido and Loria (2020) who find evidence of a structural shift in the dynamics of US inflation risks using an inflation-at-risk framework. We add to this literature by showing how fiscal and monetary regimes have been a source of changing inflation risks over time.

The remainder of the paper is structured as follows. Section 2 describes the estimation methodology, the classification of regimes and the data. Section 3 presents our baseline results, and Section 4 robustness tests and extensions. Finally, Section 5 uses our estimated models to examine how fiscal and monetary policy regimes may have contributed to the burst of inflation in 2021 and 2022. Section 6 concludes.

2 Methodology

We examine the effects of fiscal deficits on inflation by estimating Phillips curve-type models augmented with fiscal deficits, using panel data. We estimate simple linear models as well as quantile regressions that allow us to evaluate inflation tail risks. The models are estimated conditional on four policy regimes that feature different combinations of fiscal and monetary policy. In this section, we first describe the estimated models, then the construction of the four policy regimes and, finally, the data.

2.1 Econometric approach

Our baseline specification to evaluate the effects of deficits on future inflation is as follows:

$$\overline{\pi}_{i,t+1,t+2} = a_i + X'_{it}\beta + \epsilon_{it}. \tag{1}$$

where the dependent variable $\overline{\pi}_{i,t+1,t+2}$ is a simple average of one- and two-year-ahead headline inflation in country i. α_i denotes country fixed effects and $X_{i,t}$ is a vector of explanatory and control variables:

$$X'_{it} = (\Delta def_{it}, \pi_{it}, \Delta y_{it}, \Delta exc_{it}, \Delta oil_{it}). \tag{2}$$

The main covariate of interest is Δdef_{it}, which represents the year-on-year change in fiscal deficit as a percentage of GDP. π_{it} is the current level of headline inflation, year-on-year;[2] Δy_{it} denotes the year-on-year log change in real GDP; Δexc_{it} is the log change in the nominal effective exchange rate, with an increase in exc_{it} denoting an appreciation; and Δoil_{it} denotes the log change in oil prices denominated in local currency. All variables in log changes are expressed as percentages. The model is estimated using ordinary least squares.

In order to examine the possibility that changes in fiscal deficits lead to greater tail risks of inflation, we use novel methods for panel quantile regressions with fixed effects (see Machado and Santos Silva (2019)).We begin with the following location-scale model:

$$\overline{\pi}_{i,t+1,t+2} = \alpha_i + X_{it}'\beta + (\delta_i + X_{it}'\gamma)U_{it}, \tag{3}$$

where $\overline{\pi}_{i,t+1,t+2}$ and $X_{i,t}$ are defined as before. In this model, the size of the effects of explanatory variables are allowed to vary according to the observation's placement in the conditional inflation distribution. These non-linearities are driven by the scaling of the error term U by a vector of constants γ. The parameters α_i and δ_i denote country i fixed effects. α_i is the time-invariant average level of inflation within country i. δ_i is a country-specific, time-invariant scaling parameter of the distribution of U, which has the same properties for all i and t. From Eq (3), we have $\Pr[\delta_i + X_{it}'\gamma > 0] = 1$. The sequence $\{X_{it}\}$ is assumed to be strictly exogenous. [3] U_{it} are unobserved random variables, iid across countries i and years t, orthogonal to X_{it} and normalised to satisfy $E[U] = 0$ and $E[|U|] = 1$.

We obtain the conditional quantiles for inflation over the next two years using:

$$Q_{\pi}(\tau|X_{it}) = (\alpha_i + \delta_i q(\tau)) + X_{it}'\beta + X_{it}'\gamma q(\tau), \tag{4}$$

[2] While we use the headline inflation rate, we also checked that our results hold if we compute the inflation rate as the log change in the CPI index.

[3] In Appendix B we conduct simulation exercises to assess the sensitivity of our estimates to deviations from these key assumptions.

where the scalar $\alpha_i(\tau) = \alpha_i + \delta_i q(\tau)$ is the quantile-τ fixed effect for economy i. $q(\tau)$ denotes the τth quantile of the distribution of error term U, conditional on X. $\alpha_i(\tau)$ captures the time-invariant effect of individual country characteristics, which potentially vary depending on where the country lies in the conditional inflation distribution. Using this model, we estimate $\beta(\tau) = \beta + \gamma q(\tau)$, for 5 quantiles: 5%, 25%, 50%, 75% and 95%. The confidence intervals are estimated by using a block bootstrapping with 1,000 replications, clustering on country.

For a given country and year, each predicted quantile from Eq (4) represents a point in the CDF $F(\cdot)$ of the inflation forecast. To address noise in our quantile estimates, following Adrian et al. (2019), we interpolate semiparametrically the predicted quantiles using the skewed $t-$distribution (see Azzalini and Capitanio (2003)). The distribution is described by the following function:

$$f(\pi;\mu,\sigma,\alpha,\nu) = \frac{2}{\sigma} t\Big(\frac{\pi-\mu}{\sigma;\nu}\Big) T\Bigg(\alpha\frac{\mu-\pi}{\sigma}\sqrt{\frac{\nu+1}{\nu+\frac{(\pi-\mu)^2}{\sigma}}};\nu+1\Bigg). \tag{5}$$

In Eq (5), $t(\cdot)$ and $T(\cdot)$ are the PDF and the CDF of the distribution, respectively. The distributional parameters μ (location), σ (scale), ν (kurtosis), and α (skewness) are estimated for each country-year pair by minimising the mean squared error between the five predicted quantiles and the distribution-implied values. In other words, we select parameter estimates that minimize the following objective function:

$$(\hat{\mu}_{it+h}, \hat{\sigma}_{it+h}, \hat{\alpha}_{it+h}, \hat{\nu}_{it+h}) = \text{argmin} \sum_{\tau} \big(\hat{Q}_{\pi_{t+h|x_t}}(\tau|x_t) - F^{-1}\big(\tau;\mu,\sigma,\alpha,\nu\big)\big)^2. \tag{6}$$

2.2 Fiscal and monetary policy regimes

We estimate the models – both the linear model and the one for inflation-at-risk – separately for different combinations of fiscal and monetary policy. In particular, we distinguish between four possible policy combinations: "prudent" or "profligate" fiscal policy combined with "high" or "low" monetary policy independence.

2.2.1 Defining the fiscal regime

For the baseline specification, the fiscal regimes are based on a *de facto* measure. We use estimates of a fiscal policy reaction function that considers the response of primary surpluses to the debt-to-GDP ratio (see Bohn (1998)). A positive response is a sufficient condition for fiscal policy to be sustainable, in the sense that the government's intertemporal budget constraint holds. For a given country, the fiscal reaction function is:

$$s_t = \rho d_t + \alpha Z_t + \varepsilon_t, \tag{7}$$

where s_t denotes the primary surplus and d_t denotes the level of government debt-to-GDP at the beginning of the period. Z_t is a vector of control variables that affect the primary balance, such as the business cycle, the transitory component of government spending and commodity prices.

In the baseline model, we use the estimates in Mauro et al. (2015) who operationalise the approach in Bohn (1998). In particular, Mauro et al. (2015) estimate fiscal reaction functions for a panel of countries based on 25-year rolling regressions. Periods of prudent (profligate) fiscal policy are then defined as those with $\rho > 0$ ($\rho < 0$), on condition of a statistically significant coefficient at a minimum of 5% level.

In addition to providing a sufficient statistic on whether the government's intertemporal budget constraint holds, the approach has a number of advantages. Government debt-to-GDP ratios are affected by temporary shocks, such as wartime spending or business cycle fluctuations, which make it difficult to detect violations of the intertemporal budget constraint based on developments of debt alone (see Bohn (1998)).[4] Moreover, the approach is robust to changes in growth rates (g) and interest rates (r), and different debt management policies. However, the relationship between growth rates, interest rates and ρ matter for the trajectory of debt. In particular, if $\rho > (r - g/1 + r)$, the debt ratio is stationary and returns to its initial level after a shock. We also note that considering a regression of the type in Eq (7) implies close correspondence with structural models that feature different types of behaviour of the fiscal authority. For example, in Bianchi and Ilut (2017), passive (active) fiscal policy is defined as one where the fiscal authority is (not) committed to stabilising debt by adjusting taxes.

As noted by Mauro et al. (2015), the approach in Bohn (1998) was developed against the backdrop of rising debt. If the debt ratio is declining, the rejection of a positive and statistically significant ρ would indicate that the intertemporal budget constraint is violated, but in a sense of over-accumulating public assets rather than incurring excessive liabilities. That said, over our sample period, debt ratios were mostly on the rise. In particular, considering all 25-year changes in debt ratios, increasing debt ratios were four times more frequent than decreasing ones, with rising debt ratios over two times larger in absolute value than decreasing ones. (The average 25-year changes are 38 and 18 percentage points, respectively.)

As a robustness test, we also consider *de jure* classifications of fiscal regimes based on whether the economy has in place a fiscal rule for the budget balance - that is, legal numerical limits on the overall balance, the structural or cyclically adjusted balance, or the balance over the cycle.

[4] Indeed, as we discuss in the next section, in the monetary dominance regime where fiscal policy is sustainable, debt levels are on average higher than in the fiscal dominance regime.

2.2.2 Defining the monetary regime

As to monetary policy, the baseline regimes are based on *de jure* indicators of central bank independence. Given the particular importance of monetary accommodation of fiscal policy, our main measure is based on specific limitations placed on central bank lending to the public sector and enshrined in central bank laws.[5] Grilli et al. (1991) note that if the government is able to influence the quantity and conditions on which it borrows from the monetary authority, it affects the creation of base money and decreases the central bank's economic independence. Similarly, Cukierman et al. (1992) consider a central bank with tighter restrictions on lending to the public sector to be more independent in the pursuit of the price stability objective. The authors argue that providing credit to the government would likely be an important channel behind the relationship between the lack of central bank independence and inflation.

The specific measures on central bank independence we use come from Romelli (2022) who follows the entire set of legislative changes to laws concerning the central bank over time. As indices proposed in earlier literature were generally computed at specific points in time, they do not capture the full set of reforms. For a given country-year observation, we classify monetary policy independence to be low (high) if the indicator is below (above) the median of all country-year observations during the sample period.

In our case, given that we are interested in the effect of deficits on inflation, considering an exogenous indicator such as central bank independence to classify the monetary regime is arguably preferable to more endogenous alternatives, such as using the *de facto* degree of inflation stabilisation, for example. That said, in robustness tests, we use an alternative

[5] In addition to capturing restrictions on central bank purchases of government debt securities in the primary market, the indicator covers a number of other dimensions, such as whether strict amounts on loans exist and whether the loan terms are controlled by the central bank; whether the borrower can only be government or also other public sector institutions such as state-owned enterprises; whether interest rates are market-determined; and whether the maturities are limited and clearly specified in the central bank legislation.

de facto measure of the monetary policy regime, capturing the degree to which monetary policy acts to stabilise inflation. In particular, we define the regime based on whether the central bank's policy interest rate is below that suggested by a Taylor rule (Taylor (1993)).[6] We also note that the measures of *de jure* central bank independence in Romelli (2022) feature an interesting dynamic relationship with inflation outcomes, such that reforms to central bank legislation tend to follow periods of high inflation.

2.3 Data

The data are annual and cover 21 advanced economies from 1972 onwards – corresponding to the start date of the central bank independence indices.[7] The end date varies by the measures of fiscal and monetary policy regimes used. For the baseline regressions where the fiscal regimes are defined based on Mauro et al. (2015) and monetary policy regimes on Romelli (2022), the sample ends in 2011, covering four decades with diverse monetary and fiscal policy behaviour. The fiscal data are from Mauro et al. (2015). They are extended to more recent periods using data from the IMF Fiscal Monitor. Real GDP and inflation are from national sources and the nominal effective exchange rates are from the BIS. For commodity prices, we use the UNCTAD's commodity price index and the price of West Texas Intermediate (WTI) for oil. The short-term interest rates are from Jordà et al. (2017) and are supplemented by data from the OECD, Datastream and the Global Financial Data database.

[6] Still an alternative approach would be to consider *de facto* measures of central bank independence, such as political pressures on central banks recently published in Binder (2021). However, available data for long time periods is, to our knowledge, sparse.

[7] The economies included are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and the United States.

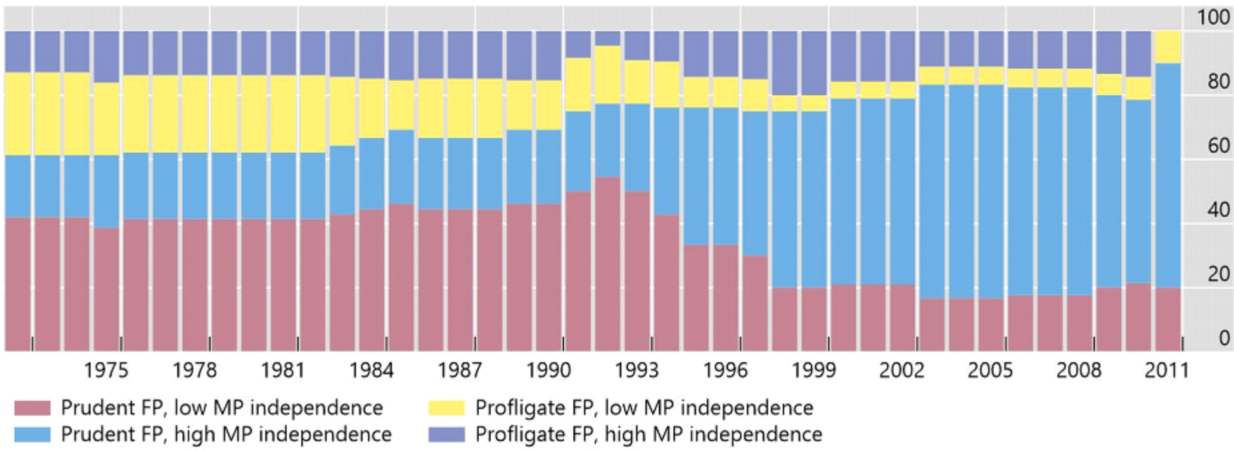


Figure 2: **Fiscal and monetary regimes over time.** The figure shows the share of economies in the four different fiscal and monetary regime combinations. Fiscal regime classification based on Mauro et al. (2015). Prudent FP: Prudent fiscal policy regime, defined as fiscal policy where the primary balance is increasing in the level of debt. Profligate FP: profligate fiscal policy regime, economies where the primary balance is not increasing in the level of debt. Monetary policy regime based on Romelli (2022). High MP independence: high monetary policy independence, defined as central banks with above median *de jure* limitations on lending to the public sector. Low MP independence: low monetary policy independence, defined as central banks with below median *de jure* limitations on lending to the public sector.

3 Baseline results

3.1 Policy regimes over time

The share of economies in the fiscal and monetary dominance regimes has changed notably over time. Figure 2 shows the share of economies in the different regimes, for each year of the sample. By the early 2010s, around 60-70% of countries were in the monetary dominance regime. By contrast, early in the sample, around 20% of economies were in this regime, which included Canada, Germany and the United States. As for fiscal dominance, the share was around 25% in the 1970s, dropping to 10% by the 1990s.

The most common combination of regimes early in the sample was the intermediate one featuring prudent fiscal policy and low monetary policy independence. This comprised a number of European countries, together with Japan and New Zealand. Overall, regimes with profligate fiscal policies have been less frequent and their shares have declined further over time.

Perhaps not surprisingly, inflation rates have on average been much higher in regimes with low monetary policy independence (7.7%) than with high independence (4.4%). By contrast, the average inflation rates in profligate and prudent fiscal regimes have been similar, 6.6% in the former and 6.1% in the latter.

While primary deficits have been smaller in prudent than in profligate fiscal regimes (primary deficits of 0.4% vs 1.6% of GDP), overall deficits have been broadly similar in the two regimes (3.0% vs 2.9% of GDP). Moreover, government debt levels have been higher in prudent regimes (55% vs 49% of GDP). Thus, primary fiscal accounts have been closer to balance in economies where overall fiscal deficits have been larger and debt ratios have been higher.

3.2 Average effect of deficits on inflation

Simple least squares estimates show that the relationships between higher deficits and future inflation vary notably between the fiscal and monetary dominance regimes (see Table 1). The effect is found to be much weaker in the monetary dominance regime than in the one characterised by fiscal dominance. In the former, a one-percentage-point increase in fiscal deficits is associated with around 0.10 percentage point increase in average inflation over the next two years (first column). By contrast, under fiscal dominance, the corresponding effect is over five times as high in magnitude (second column). The effects in both regimes are statistically significant at the 1% level.[8]

In the "intermediate" regimes the effects of deficits on inflation fall in between the two previous ones: point estimates of 0.36 (prudent fiscal and low monetary policy indepen-

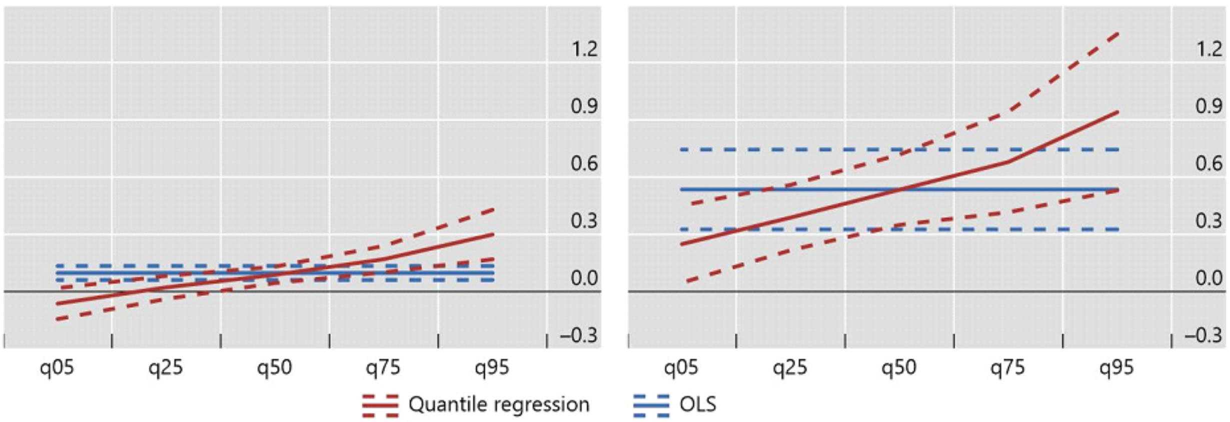
[8]All regressions also include a dummy variable (not shown) that obtains a value of 1 if, for a given country-year observation within a fiscal regime, the same observation is also classified as being in the opposite fiscal regime in another partly overlapping rolling regression in Mauro et al. (2015). In other cases, the dummy variable is assigned a value of zero.

	Monetary dominance	Fiscal dominance	Prud FP low MP indep	Profl FP high MP indep
	$\overline{\pi}_{i,t+1,t+2}$	$\overline{\pi}_{i,t+1,t+2}$	$\overline{\pi}_{i,t+1,t+2}$	$\overline{\pi}_{i,t+1,t+2}$
Δdef_{it}	0.0974***	0.536***	0.363***	0.123
	(0.0222)	(0.128)	(0.107)	(0.126)
π_{it}	0.714***	0.722***	0.763***	0.463***
	(0.0263)	(0.0797)	(0.0363)	(0.0628)
Δy_{it}	0.301***	1.005***	0.752***	0.366***
	(0.0390)	(0.101)	(0.102)	(0.0556)
Δexc_{it}	-0.0757**	0.0149	0.0162	-0.0212
	(0.0307)	(0.0271)	(0.0209)	(0.0607)
Δoil_{it}	-0.00109	-0.00811	0.00298	0.00486
	(0.00479)	(0.00559)	(0.00531)	(0.00747)
Observations	314	152	341	126
R-squared	0.747	0.692	0.659	0.391
Number of countries	14	9	13	8

Table 1: **Effects of deficits on inflation across fiscal-monetary regimes, OLS estimates.** This table shows OLS estimates of the relationship between the inflation rate over the next two years (annualised) in country i, $\overline{\pi}_{i,t+1,t+2}$, and changes in fiscal deficit-to-GDP ratio, Δdef_{it}, in year t across different fiscal-monetary policy regimes. Fiscal regimes are classified as prudent (Prud FP) or profligate (Profl FP), based on Mauro et al. (2015). The monetary regimes, low MP indep and high MP indep, are defined as being low or high independence based on the degree of legal limitations on central bank lending to the public sector in Romelli (2022). Monetary dominance is defined as the combination of prudent fiscal policy and high monetary independence. Fiscal dominance is defined as profligate fiscal policy and low monetary independence. The control variables are π_{it}: annual inflation rate; Δy_{it}: GDP growth; Δexc_{it}: log change in the nominal effective exchange rate; Δoil_{it}: log change in the local price of oil. The regression also includes country fixed effects. Standard errors clustered at the country level in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

dence; third column) and 0.12 (profligate fiscal and high monetary policy independence; fourth column). However, the latter estimate is not statistically significant at conventional levels.

We also find some relevant results regarding the other control variables in Table 1. Real GDP growth is associated with economically stronger effects on inflation in the regime of fiscal dominance than with monetary dominance. Similar to fiscal deficits, the coefficient on real GDP growth in the intermediate regimes falls between those estimated in the fiscal and monetary dominance regimes. In all regimes, the coefficient on real GDP growth is statistically significant at 1% level. Moreover, an exchange rate appreciation obtains the expected negative sign with a statistically significant coefficient only in the regime of



(a) Monetary dominance regime

(b) Fiscal dominance regime

Figure 3: **Quantile regression estimates of fiscal deficits on inflation.** This figure shows the estimated coefficients in quantile regressions of inflation rate over the next two years (annualised) in country i, $\overline{\pi}_{i,t+1,t+2}$, on changes in the fiscal deficit-to-GDP ratio in year t. Coefficients are shown by the q% quantile (x-axis); e.g. q50 denotes the 50% quantile. The left-hand panel shows coefficients estimated in monetary dominance regimes while the right-hand panel shows the coefficients estimated in fiscal dominance regimes. Quantile estimates are shown with 90% confidence bands using a block bootstrap clustered by country. OLS estimates are shown with 90% confidence bands clustered by country.

monetary dominance, such that an appreciation is associated with lower future inflation. The statistical insignificance of oil prices - and the negative coefficients in two regimes - owes to the high-frequency fluctuation that is characteristic of commodity prices. Indeed, if we replace future inflation by current inflation as the dependent variable in the estimation, the change in oil prices obtain a statistically significant positive coefficient in all four regimes.

3.3 Inflation-at-risk from higher fiscal deficits

The estimates in the previous section showed how future inflation moves, on average, in response to fiscal deficits in the different policy regimes. At the same time, policymakers may want to avoid extreme inflation outcomes and take actions that reduce their likelihood. In this section, we examine the behaviour of the entire inflation forecast distribution under the different policy regimes, as well as the association between higher deficits and tail risks to inflation. We focus on the two corner regimes of monetary and fiscal dominance.

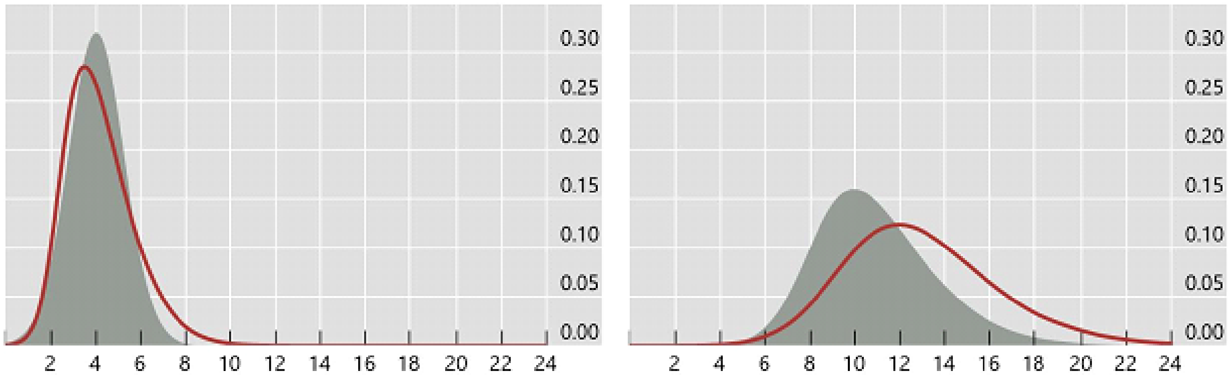
Inflation forecast quantiles	5% $\overline{\pi}_{i,t+1,t+2}$	25% $\overline{\pi}_{i,t+1,t+2}$	50% $\overline{\pi}_{i,t+1,t+2}$	75% $\overline{\pi}_{i,t+1,t+2}$	95% $\overline{\pi}_{t+1,t+2}$
Δdef_{it}	0.251*	0.390***	0.536***	0.679***	0.941***
	(0.145)	(0.106)	(0.111)	(0.169)	(0.245)
π_{it}	0.653***	0.687***	0.722***	0.757***	0.821***
	(0.0878)	(0.0649)	(0.0718)	(0.0772)	(0.115)
Δy_{it}	0.745***	0.872***	1.005***	1.136***	1.374***
	(0.170)	(0.0983)	(0.0766)	(0.0976)	(0.194)
Δexc_{it}	-0.0483**	-0.0175	0.0149	0.0466*	0.105**
	(0.0234)	(0.0202)	(0.0219)	(0.0281)	(0.0447)
Δoil_{it}	-0.000343	-0.00413	-0.00810*	-0.0120*	-0.0191*
	(0.00527)	(0.00390)	(0.00475)	(0.00649)	(0.0106)
Observations	152	152	152	152	152

Table 2: **Quantile regression estimates, fiscal dominance regime.** This table shows the estimated coefficients in quantile regressions of inflation rate over the next two years (annualised) in country i, $\overline{\pi}_{i,t+1,t+2}$, on changes in the fiscal deficit-to-GDP ratio in year t, Δdef_{it}, annual inflation rate π_{it}, GDP growth, Δy_{it}, log change in the nominal effective exchange rate Δexc_{it}, and log change in the local price of oil, Δoil_{it}. Estimated regressions include quantile-τ fixed effect for economy i. Block bootstrap standard errors clustered by country shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Using the methodology described in Section 2, Figure 3 shows the coefficient on fiscal deficits from the quantile regression, for the monetary dominance (left panel) and fiscal dominance (right panel) regimes. Moving from left to right within the panels implies moving from lower to higher quantiles, i.e. from the 5% to the 95% quantile.

Figure 3 suggests that higher fiscal deficits increase upside risks to inflation, as the coefficient on deficits is higher in the upper quantiles of the inflation forecast distribution. Moreover, the effect is particularly pronounced in the fiscal dominance regime (right panel). In this case, at the 95% quantile, a one percentage point rise in fiscal deficits is associated with close to one percentage point increase in future inflation (see also the last column of Table 2). This effect is around twice as high as at the median and four times as high as at the left tail (5%) of the distribution.

Under monetary dominance, deficits also raise upside inflation risks, but the effects are less statistically significant and much lower in economic terms. In this case, the right-tail (95% quantile) shifts by 0.3 ppts when deficits rise by one percentage point (see also the



(a) Monetary dominance

(b) Fiscal dominance

Figure 4: **Fiscal deficits increase inflation by more in fiscal dominance regimes.** This figure shows the conditional forecast distribution of the inflation rate (annualised) over the next two years. The grey shaded density shows the conditional distribution evaluated at the sample means of all variables. The red density shows the conditional distribution evaluated at a two standard deviation increase in the change in the fiscal deficit, with other control variables at their means. The left-hand panel shows the conditional distributions of inflation in the monetary dominance regime. The right-hand panel shows the conditional distributions of inflation in the fiscal dominance regime.

last column of Table 3). Moreover, the effects at the 5% and the 25% quantiles are not statistically different from zero.

The differences in inflation behaviour in the fiscal and monetary dominance regimes go beyond the relationship between deficits and inflation. In particular, Figure 4 highlights key differences in terms of two moments of the inflation forecast distribution. Setting all variables at their regime-dependent means, the grey distributions show that inflation is higher on average and its variance is larger in the fiscal dominance compared to the monetary dominance regime. While the red line shows the conditional distribution evaluated at a two standard deviation increase in the change in the fiscal deficit shifts much further to the right in the fiscal dominance regime compared to the distribution under monetary dominance.

Fiscal and monetary dominance regimes also feature differences in terms of sensitivities to real GDP growth (see the third rows in Table 2 and Table 3). In particular, real GDP growth has a stronger relationship with future inflation in the fiscal dominance than

Inflation forecast quantiles	5% $\overline{\pi}_{i,t+1,t+2}$	25% $\overline{\pi}_{i,t+1,t+2}$	50% $\overline{\pi}_{i,t+1,t+2}$	75% $\overline{\pi}_{i,t+1,t+2}$	95% $\overline{\pi}_{t+1,t+2}$
Δdef_{it}	-0.0630	0.0222	0.0879***	0.170***	0.299***
	(0.0522)	(0.0333)	(0.0297)	(0.0400)	(0.0785)
π_{it}	0.549***	0.636***	0.704***	0.788***	0.921***
	(0.0669)	(0.0418)	(0.0452)	(0.0822)	(0.161)
Δy_{it}	0.254***	0.279***	0.298***	0.322***	0.360***
	(0.0607)	(0.0400)	(0.0389)	(0.0577)	(0.104)
Δexc_{it}	-0.0882**	-0.0816**	-0.0764**	-0.0700**	-0.0599
	(0.0390)	(0.0339)	(0.0316)	(0.0351)	(0.0485)
Δoil_{it}	0.00319	0.000913	-0.000842	-0.00303	-0.00649
	(0.00601)	(0.00455)	(0.00423)	(0.00477)	(0.00651)
Observations	314	314	314	314	314

Table 3: **Quantile regression estimates, monetary dominance regime.** This table shows the estimated coefficients in quantile regressions of inflation rate over the next two years (annualised) in country i, $\overline{\pi}_{i,t+1,t+2}$, on changes in the fiscal deficit-to-GDP ratio in year t, Δdef_{it}, annual inflation rate π_{it}, GDP growth Δy_{it}, log change in the nominal effective exchange rate Δexc_{it}, and log change in the local price of oil, Δoil_{it}. Estimated regressions include quantile-τ fixed effect for economy i. Block bootstrap standard errors clustered by country shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

in the monetary dominance regime across the entire distribution. At the median of the distribution, the relationship in the fiscal dominance regime is over three times as strong as in the monetary dominance regime; at the 95% quantile, it is almost four times as strong. Across both distributions, all coefficients on real GDP growth are statistically significant at the 1% level.

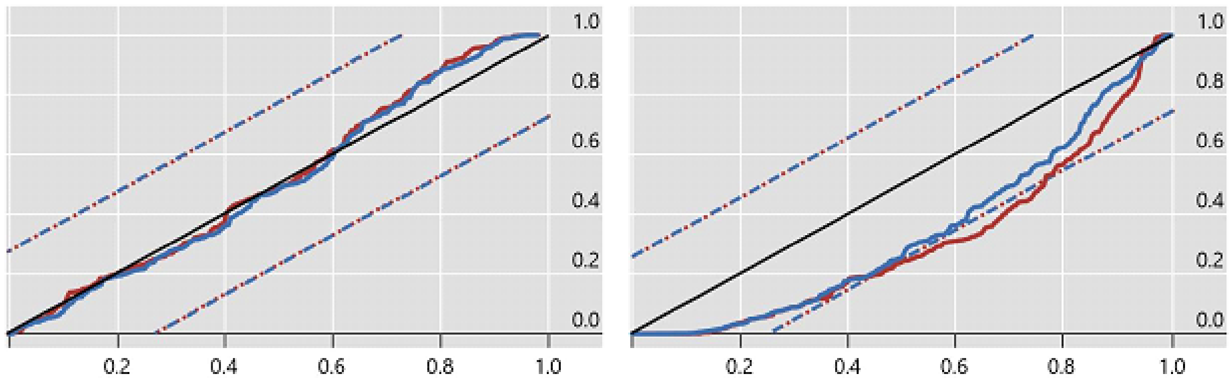
At the same time, both fiscal and monetary dominance display similar non-linearities between current and future inflation. In both regimes inflation persistence is stronger at the right than at the left tail of the forecast distribution, as shown by the higher coefficients on current inflation at the right tail. The finding is consistent with prices being adjusted more frequently at high inflation rates (see eg Alvarez et al. (2019)).

For the intermediate regimes, the effects of higher deficits on inflation risks are more mixed. The regime featuring prudent fiscal policy and low monetary policy independence displays similar non-linearities to the fiscal and monetary dominance regimes, with higher deficits raising upside inflation risks (see Annex Table A.1). By contrast, when fiscal policy is profligate but monetary independence is high, the effects of deficits are not statistically significant at conventional levels (see Annex Table A.2).

Taken together, the results suggest that in both fiscally prudent and profligate environments, higher deficits are associated with lower future inflation if monetary policy is independent rather than non-independent. These findings appear consistent with previous research highlighting the association between higher central bank independence and lower inflation (eg Cukierman et al. (1992); Klomp and Haan (2010); Garriga and Rodriguez (2020)). However, our results suggest that it is not only monetary policy but the combination of fiscal-monetary policy regimes that matters for inflation performance. Relatedly, we also highlight significant differences between the monetary and fiscal dominance regimes in terms of the conditional mean and variance of future inflation. Moreover, while some earlier studies do not find significant effects of deficits on inflation when inflation is low (eg Fischer et al. (2002) and Catao and Terrones (2005)), we also report effects at the lower quantiles of the inflation forecast distribution, but note that such effects are regime-dependent.

4 Extensions and robustness tests

In this section, we consider a number of extensions and robustness tests to the baseline model, focusing on the fiscal and monetary dominance regimes. First, we examine to what extent the inclusion of fiscal deficits improves the out-of-sample forecasting performance of the inflation-at-risk model. Second, we change the way fiscal and monetary policy regimes are defined. Third, we evaluate the robustness of the results to excluding the recent period of low inflation. Fourth, we replace changes in fiscal deficits by a measure of fiscal shocks in the model. Finally, we examine asymmetries between increases and decreases in fiscal deficits in terms of their effect on future inflation.



(a) Monetary dominance

(b) Fiscal dominance

Figure 5: **Cumulative distribution of the probability integral transform in models with and without fiscal deficits.** The x-axis shows the quantile and the y-axis the empirical cumulative distribution. The blue lines show the probability integral transform in the baseline model with changes in fiscal deficits, while the red lines show the probability integral transform in the baseline model without deficits. 95% critical values are included around the 45 degree line.

4.1 Forecasting performance

In examining the out-of-sample predictive ability of our model, our focus is on the extent to which the inclusion of deficits in the Phillips curve type model helps to forecast inflation across the quantiles in the fiscal and monetary dominance regimes. To this end, we compute the empirical cumulative distribution of the probability integral transform (PIT; see also Adrian et al. (2019)). We check how closely the fraction of outcomes is to the predicted quantile $Q_\pi(\tau|X_{it})$. Observations close to the 45 degree line between τ and the empirical cumulative distribution would suggest a well calibrated model. Sample uncertainty is accounted for by 95% confidence bands around the 45 degree line.

Figure 5 shows that including deficits, shown by the blue line, helps to improve the forecasting properties of the model relative to the model without deficits (red line). This is especially so in the fiscal dominance regime. In that regime, the empirical distribution of the model with fiscal deficits tends to fall closer to the 45 degree line than of the model without fiscal variables.

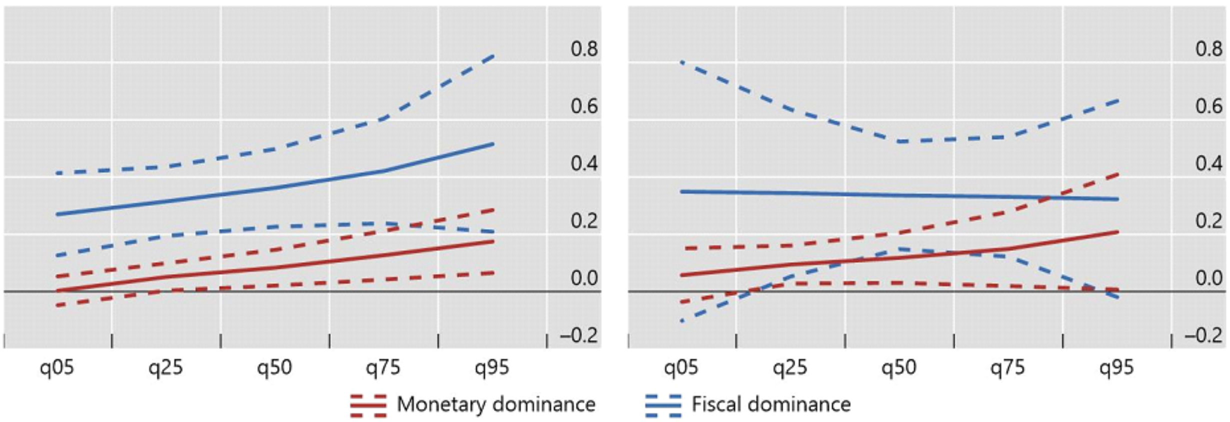
4.2 Alternative regime classifications

We then change the classification of the policy regimes. First, instead of using estimates of the fiscal policy reaction function, we define the fiscal regimes based on whether a country has in place a fiscal rule for the budget balance. We draw on the recently published dataset of Davoodi et al. (2022). The data are available from 1985 onwards. We consider rules of both national and supranational types, and covering either the overall balance, the structural or cyclically adjusted balance, or the balance over the cycle. As noted by Schaechter et al. (2012), budget balance rules can help ensure debt sustainability. Moreover, as a *de jure* indicator, the existence of a fiscal rule provides a useful comparison with the *de facto* measure yielded by the fiscal reaction function. Annex Figure A.1 displays the evolution of regimes over time when the presence of fiscal rules is used to define the fiscal regime.

Figure 6, left-hand panel, shows that the results obtained with fiscal rules are similar to the baseline model. In particular, the relationship between deficits and inflation is stronger across the inflation forecast distribution in the fiscal dominance than in the monetary dominance regime. Notably, this result obtains even as the high inflation periods of the 1970s are excluded from the sample due to data availability.[9]

Then, we consider a different indicator for the monetary policy regime. We evaluate the extent to which monetary policy has been stabilising, by comparing the level of actual short-term interest rate with that prescribed by a Taylor rule. Periods of interest rates not more than 50 basis points below the Taylor prescribed benchmarks are then regarded as stabilising monetary policy. In the opposite case, monetary policy is considered overly accommodative if interest rates are below the Taylor rule benchmark by more than 50 basis

[9]Data on fiscal rules only start in 1985. Given that data for fiscal rules and monetary policy independence are jointly available until 2017, these estimates also cover more years of the recent low inflation period. In additional robustness tests, we confirm that our results are qualitatively similar if we exclude the high inflation period in our baseline specification.



(a) Fiscal rules

(b) Taylor rules

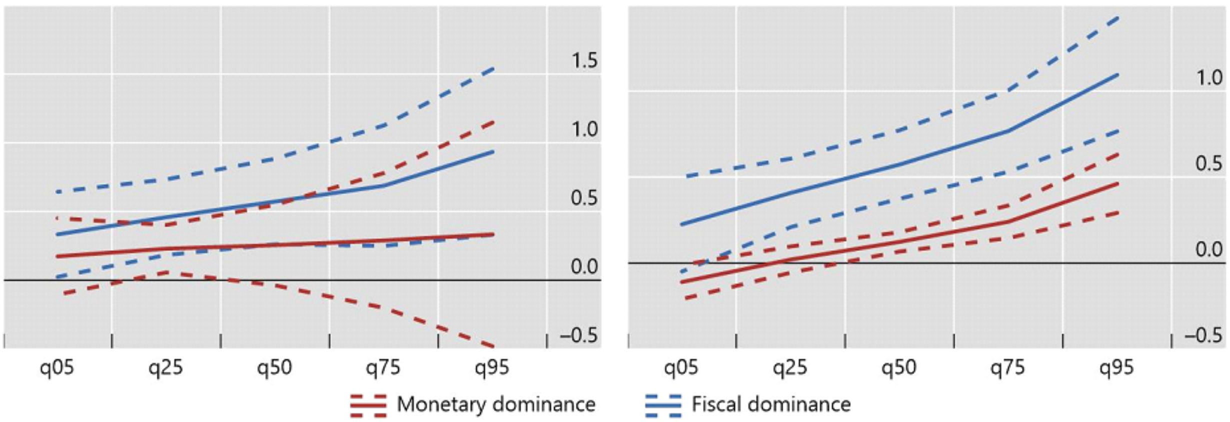
Figure 6: **Quantile regression estimates based on alternative regime classification metrics.** The figure shows the estimated coefficients in quantile regressions of inflation rate over the next two years (annualised) in country i, $\overline{\pi}_{i,t+1,t+2}$, on changes in the fiscal deficit-to-GDP ratio in year t. Coefficients are shown by the q% quantile (x-axis); e.g. q50 denotes the 50% quantile. The red lines show estimates in the monetary dominance regime while the blue lines show estimates in the fiscal dominance regime. The left-hand panel shows estimates when the fiscal regime is based on fiscal rules. Countries with fiscal rules for a budget balance are classified as prudent, those without as profligate. The right-hand panel shows estimates when the monetary regime is based on whether short-term interest rates in the economy are above or below those from estimated Taylor rules. Dotted lines show 90% confidence bands using block bootstraps clustered by country.

points.[10] The Taylor rule parameters are based on Hofmann and Bogdanova (2012).[11] We plot the evolution of the regimes over time in Annex Figure A.2, for the case where the baseline fiscal regimes obtained from fiscal reaction functions are combined with monetary regimes based on Taylor rules.

The right-hand panel of Figure 6 shows that the results are robust to defining monetary regimes with this *de facto* measure based on whether interest rates are above or below those prescribed by our estimated Taylor rules. Consistent with the baseline findings, the effects on inflation from changes in fiscal deficits are higher in economies where interest rates are below those prescribed by our estimated Taylor rules and the fiscal authority is

[10]The 50 basis points adjustment is done in order to avoid classifying regimes as overly accommodative when their interest rates are close to Taylor rule benchmarks. Moreover, while we use CPI as the relevant price index for all economies, the official inflation target for the US is specified in terms of the PCE index, for which inflation tends to be around 0.5 percentage points below that for the CPI.

[11]See in particular the footnote to Graph 1 in Hofmann and Bogdanova (2012).



(a) Pre-1994 estimates

(b) Using fiscal shocks

Figure 7: **Quantile regression estimates in pre-1994 sample and fiscal shocks.** The left-hand figure shows the estimated coefficients in quantile regressions of inflation rate over the next two years (annualised) in country i, $\overline{\pi}_{i,t+1,t+2}$, on changes in the fiscal deficit-to-GDP ratio in year t estimated over the pre-1994 sample. The right-hand panel shows estimated coefficients in quantile regressions of inflation rate over the next two years (annualised) in country i, $\overline{\pi}_{i,t+1,t+2}$, on fiscal shocks measured as deviations from estimated fiscal rules. Coefficients are shown by the q% quantile (x-axis); e.g. q50 denotes the 50% quantile. In both panels, the red lines show estimates in the monetary dominance regime while the blue lines show estimates in the fiscal dominance regime. Dotted lines show 90% confidence bands using block bootstraps clustered by country.

profligate. However, the degree of non-linearity is smaller than in the baseline results for fiscal dominance. Moreover, the confidence bands are wide. The estimated coefficients on fiscal deficit changes are lower in regimes where interest rates are above those prescribed by Taylor rules and the fiscal regime is prudent.

4.3 Excluding the low-inflation period

Next, we evaluate the robustness of the results to excluding the recent period of low inflation. The frequency of economies in the monetary dominance regime has increased notably over time, while at the same time inflation has trended down in all economies. This raises the question of whether our results for the differences between the fiscal and monetary dominance regimes mostly capture this "time effect" of lower inflation that has occurred concurrently with regimes shifting from fiscal to monetary dominance. To examine this issue, we estimate the model for the pre-1994 period that features considerable heterogeneity in terms of the regimes across countries. The left-hand panel of Figure 7 shows that the results are robust to the exclusion of the low inflation period from the sample, but the degree of non-linearity across quantiles is generally smaller.

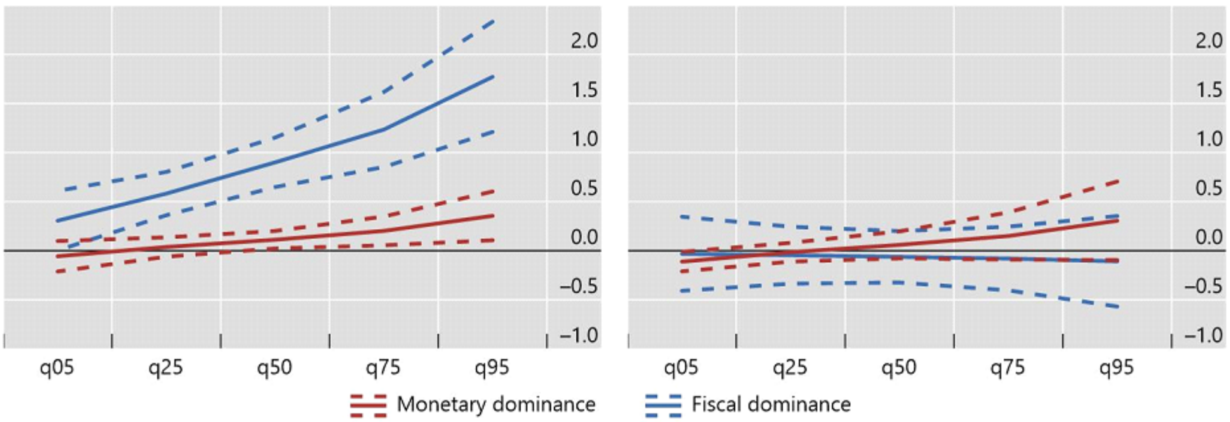
4.4 Using fiscal shocks

As deficits could be correlated with and partly endogenous to some other explanatory variables, in particular GDP growth, we replace fiscal deficits by a more exogenous measure of fiscal policy. Following the approach of Corsetti et al. (2012) who identify fiscal shocks as residuals from an estimated spending rule, we estimate in a panel set-up a fiscal rule that links primary deficits to lagged primary deficits, the lagged level of government debt and the output gap. Then, we use the residual from this regression as an exogenous measure of fiscal expansion. The right-hand panel of Figure 7 confirms that using expansionary fiscal shocks yields similar results to overall deficits, in particular large differences between the regimes of fiscal and monetary dominance.

4.5 Examining asymmetries

Next, we examine asymmetries between increases and decreases in fiscal deficits in terms of their effects on future inflation. To do this, we include positive and negative changes in deficits as separate explanatory variables. Figure 8 shows that the effects on inflation stem from increases rather than from decreases in deficits, as the coefficient on the latter is close to zero and statistically insignificant across both fiscal and monetary dominance regimes.[12]

[12] Previous literature has highlighted asymmetric effects of contractionary vs expansionary monetary policy on prices, see e.g. Barnichon and Matthes (2018) and Debortoli et al. (2020).



(a) Increases in deficits (b) Decreases in deficits

Figure 8: **Quantile regression estimates, increases and decreases in fiscal deficits.** The left-hand figure shows the estimated coefficients in quantile regressions of inflation rate over the next two years (annualised) in country i, $\overline{\pi}_{i,t+1,t+2}$, on increases in the fiscal deficit-to-GDP ratio in year t while the right-hand panel shows estimates of inflation over the next two years on decreases in the fiscal deficit-to-GDP ratio. Coefficients are shown by the q% quantile (x-axis); e.g. q50 denotes the 50% quantile. In both panels, the red lines show estimates in the monetary dominance regime while the blue lines show estimates in the fiscal dominance regime. Dotted lines show 90% confidence bands using block bootstraps clustered by country.

5 Inflation and Covid-19

In this section, we use our model to shed light on the sudden burst of inflation following the Covid-19 pandemic. The shift in consumption spending from services to goods and supply bottlenecks are important factors that might have contributed to it. At the same time, in many economies the fiscal stimulus has been exceptionally large and monetary policy has remained largely accommodative during the recovery phase (see eg BIS (2022)).

Such a strong macroeconomic stimulus followed a period in which the tenets of sound macroeconomic policy had also been questioned. In particular, in the years preceding the pandemic, persistently low inflation and interest rates had strengthened the belief that economies could sustain higher public debt levels and that countries should not rush to reverse fiscal policy lest they jeopardise the recovery. Indeed, many commentators attributed the sluggish growth in the years following the GFC to the rapid reversal of fiscal policy in 2010-11 and warned against making the same mistake in the exit from the pandemic. In addition, with inflation persistently low and nominal policy rates at or close to their effective lower bound pre-pandemic, many central banks judged that downside risks to employment and inflation had increased. In other words, the recent years may potentially represent a shift towards laxer fiscal and monetary policies. Based on our empirical findings, such a shift would imply a stronger impact of fiscal policy on inflation.

To examine this hypothesis, we perform a forecasting exercise using the estimated OLS coefficients for the fiscal and monetary dominance regimes and data for 2020 as an input. Based on the forecasts shown in Figure 9 the high inflation outcomes following the Covid-19 pandemic appear more consistent with a regime characterised by fiscal rather than by monetary dominance: for three quarters of the sample economies, actual outcomes during 2021-22 fall within the confidence intervals under the fiscal dominance regime; by contrast, only for two countries is the inflation outcome consistent with a regime of monetary dominance. Our results therefore support the hypothesis that the recent burst of inflation also owes to the strong macroeconomic stimulus and a potential change in the regime in which fiscal and monetary policies operate.

6 Conclusions

Using data for a panel of 21 advanced economies over four decades, this paper shows that the association between higher deficits and future inflation crucially depends on the underlying fiscal and monetary policy regimes. In particular, the inflationary consequences are significantly stronger under fiscal dominance regimes, i.e. when the government places less emphasis on stabilising debt and when monetary policy is less committed to price stability. Moreover, both the mean and variance of future inflation are higher under fiscal dominance compared to monetary dominance. We also show that the relationship between deficits and inflation varies across the conditional inflation distribution, being stronger at

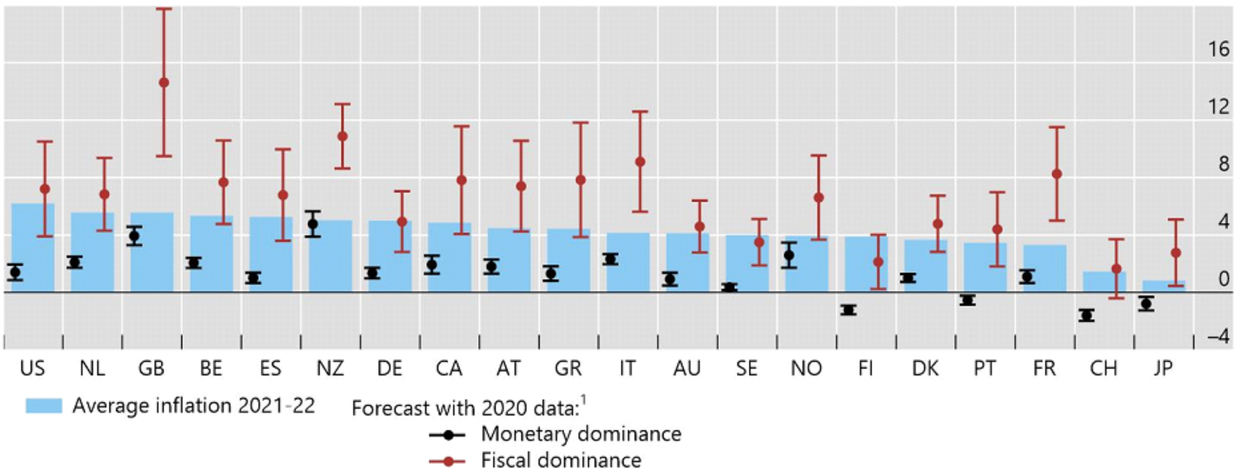


Figure 9: **Inflation outcomes during Covid-19 compared with forecasts under monetary and fiscal dominance**. The figure shows the average inflation outcomes in 2021-22 (blue bars) and the model-implied forecasts under monetary dominance (black line) and fiscal dominance (red line). The dot corresponds to the point forecast and the error bars to the 99% confidence interval. For GDP growth, average of quarterly growth over Q1 2020-Q2 2021, transformed into annualised rate. For oil prices in domestic currency, growth over the same period. Inflation for 2022 is the Consensus forecast for 2022, made in June 2022. IE not shown; for IE, the average inflation outcome is 4.3%; the forecast under monetary dominance 5.1% (confidence band 3.8-6.4%); and the forecast under fiscal dominance 19.0% (confidence band 13.4-24.6%).

the right tail of the distribution, especially under fiscal dominance. These results are robust to different approaches of identifying the policy regimes, as well as to excluding the recent period of low inflation from the analysis.

Our findings suggest that changes in policy frameworks may have a sizeable impact on inflation. First, changes in fiscal frameworks, which reduce fiscal discipline or make increasing public debt levels more tolerable, may increase upside inflation risks. Second, recent reviews of monetary policy strategy, such as for example the Federal Reserve's adoption of average inflation targeting, may have raised the inflationary effect of recent fiscal stimulus. In light of surprisingly high inflation following the Covid-19 pandemic, this may be a fruitful avenue for future research.

Although our findings are based on the long-run historical experience of inflation in advanced economies, our results also have lessons for emerging market and less developed economies. These include the importance of fiscal as well as monetary frameworks, and their interaction in influencing the mean, volatility and upside risks to inflation. Our findings suggest that similar analysis for emerging economies could shed light on the differential success in taming inflation in emerging Asia compared with that in Latin America.

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Appendix A: Tables and Figures

Inflation forecast quantiles	5% $\overline{\pi}_{t+1,t+2}$	25% $\overline{\pi}_{t+1,t+2}$	50% $\overline{\pi}_{t+1,t+2}$	75% $\overline{\pi}_{t+1,t+2}$	95% $\overline{\pi}_{t+1,t+2}$
Δdef_{it}	0.244***	0.304***	0.350***	0.412***	0.526**
	(0.0914)	(0.0835)	(0.0975)	(0.139)	(0.213)
π_{it}	0.541***	0.652***	0.737***	0.853***	1.066***
	(0.0448)	(0.0281)	(0.0324)	(0.0627)	(0.113)
Δy_{it}	0.681***	0.716***	0.743***	0.780***	0.848***
	(0.133)	(0.101)	(0.0972)	(0.118)	(0.206)
Δexc_{it}	-0.0223	-0.00310	0.0117	0.0317	0.0686
	(0.0241)	(0.0169)	(0.0193)	(0.0305)	(0.0531)
Δoil_{it}	0.00655	0.00478	0.00340	0.00154	-0.00187
	(0.00595)	(0.00422)	(0.00458)	(0.00679)	(0.0125)
Observations	341	341	341	341	341

Table A.1: **Quantile regression estimates in prudent fiscal policy, low independence monetary policy regimes.** This table shows the estimated coefficients in quantile regressions of inflation rate over the next two years (annualised) in country i, $\overline{\pi}_{i,t+1,t+2}$, on changes in the fiscal deficit-to-GDP ratio in year t, Δdef_{it}, annual inflation rate π_{it}, GDP growth Δy_{it}, log change in the nominal effective exchange rate Δexc_{it}, and log change in the local price of oil, Δoil_{it}. Estimated regressions include quantile-τ fixed effect for economy i. Block bootstrap standard errors clustered by country shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Inflation forecast quantiles	5% $\overline{\pi}_{t+1,t+2}$	25% $\overline{\pi}_{t+1,t+2}$	50% $\overline{\pi}_{t+1,t+2}$	75% $\overline{\pi}_{t+1,t+2}$	95% $\overline{\pi}_{t+1,t+2}$
Δdef_{it}	0.119	0.121	0.123	0.125	0.127
	(0.203)	(0.101)	(0.120)	(0.204)	(0.333)
π_{it}	0.326***	0.399***	0.454***	0.512***	0.608***
	(0.110)	(0.0862)	(0.0917)	(0.119)	(0.189)
Δy_{it}	-0.00834	0.191***	0.341***	0.501***	0.764***
	(0.183)	(0.0656)	(0.0685)	(0.104)	(0.180)
Δexc_{it}	-0.0427	-0.0312	-0.0226	-0.0134	0.00170
	(0.0526)	(0.0530)	(0.0620)	(0.0790)	(0.104)
Δoil_{it}	0.0137*	0.00900	0.00546	0.00166	-0.00456
	(0.00711)	(0.00645)	(0.00689)	(0.00819)	(0.0110)
Observations	126	126	126	126	126

Table A.2: **Quantile regression estimates in profligate fiscal policy, high independence monetary policy regimes.** This table shows the estimated coefficients in quantile regressions of inflation rate over the next two years (annualised) in country i, $\overline{\pi}_{i,t+1,t+2}$, on changes in the fiscal deficit-to-GDP ratio in year t, Δdef_{it}, annual inflation rate π_{it}, GDP growth Δy_{it}, log change in the nominal effective exchange rate Δexc_{it}, and log change in the local price of oil, Δoil_{it}. Estimated regressions include quantile-τ fixed effect for economy i. Block bootstrap standard errors clustered by country shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

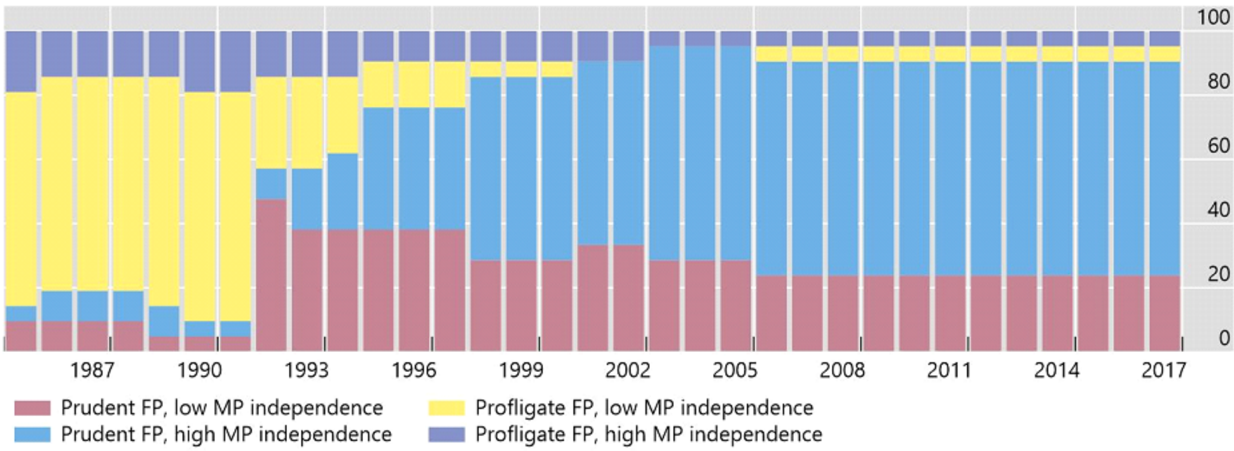

Figure A.1: **Fiscal and monetary regimes over time, based on *de jure* fiscal rules to classify fiscal regimes.** The figure shows the share of economies in the four different fiscal and monetary regime combinations. Fiscal regime classification is based *de jure* fiscal rules. Countries with fiscal rules for a balanced budget are classified as prudent, those without as profligate. Monetary policy regime based on Romelli (2022). High MP independence: high monetary policy independence, defined as central banks with above median *de jure* limitations on lending to the public sector. Low MP independence: low monetary policy independence, defined as central banks with below median *de jure* limitations on lending to the public sector.

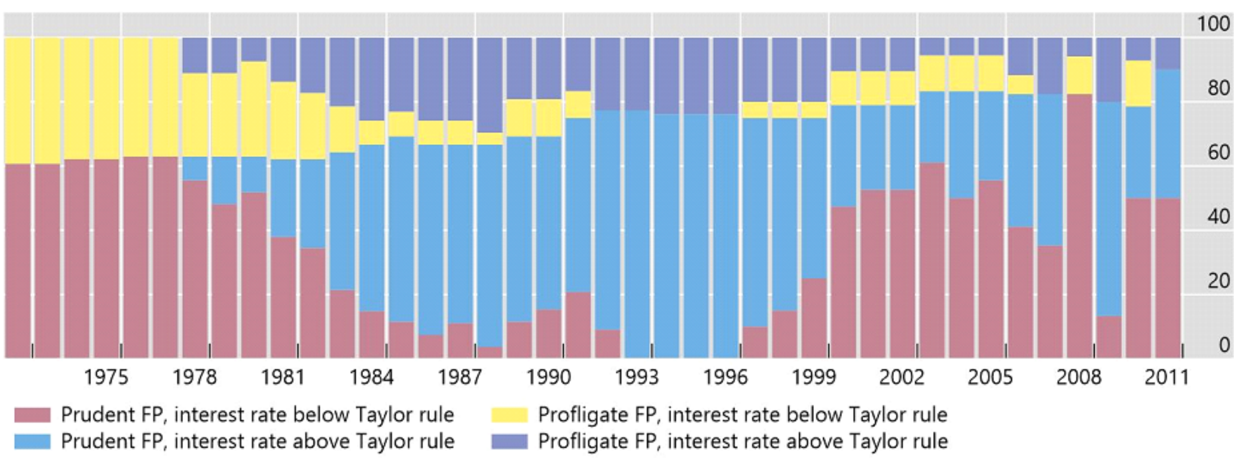

Figure A.2: **Fiscal and monetary regimes over time, based on deviations from Taylor rules to classify monetary regimes.** The figure shows the share of economies in the four different fiscal and monetary regime combinations. Fiscal regime classification based on Mauro et al. (2015). Prudent FP: Prudent fiscal policy regime, defined as fiscal policy where the primary balance is increasing in the level of debt. Profligate FP: profligate fiscal policy regime, economies where the primary balance is not increasing in the level of debt. Monetary policy regime based on whether short-term interest rates in the economy are above or below those from estimated Taylor rules.

Appendix B: Robustness of estimation techniques

The quantiles via moments estimation procedure of Machado and Santos Silva (2019) solves a number of challenges in extending quantile regression methods to panel data, but the asymptotic proofs require certain assumptions about the data generating process (DGP) that may not hold in our data. In this appendix, we examine the sensitivity of estimates to deviations from the key assumption that the sequence $\{X_{it}\}$ of regressors is assumed to be strictly exogenous and $i.i.d.$ for any country i and independent across i. Two factors are likely to lead to deviations from this assumption. First, inflation persistence leads to serial correlation in the errors. As is well know from time-series econometrics, this can lead to a bias in small samples. In addition, in a panel setting with fixed effects, this can lead to an additional source of bias (Nickell (1981)).[13] Second, interconnections across countries, most clearly within the euro area through correlations in the nominal effective exchange rate, but also through other factors such as common oil shocks and global value chains, would violate the assumption of independent regressors across countries.

B.1 Monte Carlo simulation

In the main results of this paper, we document significant non-linearities in the effects of lagged inflation and fiscal deficits across the inflation distribution in advanced economies. We verify the robustness of our estimation technique using a Monte Carlo simulation, in which we explore a few departures of our data from the assumptions used to derive the location-scale model in Machado and Santos Silva (2019). In particular, using a simulated data set, we show that through the effect of noise due to persistence and cross-correlation in the regressors, the quantile regression estimation appears to understate the true degree of non-linearities in the simulated data. In the context of our real-world data, the simulation

[13] Machado and Santos Silva (2019) investigate potential bias arising from fixed effects in quantile regressions finding that the bias is reasonal for $n/T < 10$. In our case $n = 21$ and $T = 40$.

exercise suggests that the non-linearities in the effects of fiscal deficits and lagged inflation may be even larger than our reported estimates.

We describe the simulation technique and results in further detail below:

For the Monte Carlo exercise we restrict the number of countries and time periods to match our baseline sample of $n = 21$ and $T = 40$. We then simulate time series for our dependent variable inflation and the regressors as follows:

We break up the countries into three "types" based on whether they belong to the euro area in the latter years of the data.

For all countries, regardless of type, we characterize the DGP as follows:

- Each country is assigned two fixed effects, as in Machado and Santos Silva (2019). The first fixed effect, α_i corresponds to the country-specific time-invariant average inflation. For each country, this fixed effect is drawn randomly from a normal distribution with mean 5 and standard deviation 2.[14] The second fixed effect, δ_i describes the countries' time invariant average level of scaling applied to the error term. Intuitively, the second fixed effect allows inflation in some countries to respond more or less strongly to random shocks relative to other countries in the sample. For each country, the second fixed effect is randomly drawn from the standard normal distribution.

- $\pi_{i,t} \sim AR(1), \epsilon_{i,t} \sim \mathcal{N}(\mu_\pi, \sigma^2_\pi)$

- $\Delta def_{i,t} \sim \mathcal{N}(\mu_{\Delta def}, \sigma^2_{\Delta def})$

- $\Delta y_{i,t} \sim \mathcal{N}(\mu_{\Delta y}, \sigma^2_{\Delta y})$

- $\Delta oil_t \sim \mathcal{N}(\mu_{\Delta oil}, \sigma^2_{\Delta oil})$

[14] These moments were selected based on an approximation of the average inflation distribution across advanced economies. The estimation results are relatively insensitive to the choice of moments.

We assume that inflation $\pi_{i,t}$ is an AR(1) process, while fiscal deficits $\Delta def_{i,t}$, output growth $\Delta y_{i,t}$, and oil shocks $\Delta oil_{i,t}$ are assumed to be *i.i.d.* with the means and variances taken from the unconditional moments of our data. In addition, we allow for cross-correlation across countries in our simulated exchange rate variable $\Delta exc_{1,t}$. In particular, our simulation assumes three types of countries:

Type 1 (Non-euro area Country): Country 1 exchange rate growth is uncorrelated with euro exchange rate growth. I.e., $\Delta exc_{1,t} \sim \mathcal{N}_1(\mu_{\Delta exc}, \sigma^2_{\Delta exc})$.

Type 2 & 3 (Monetary Union): Exchange rate growth is perfectly correlated for later years of the sample due to the introduction of a common currency.[15] For all t, we assume $\Delta exc_{2,t}, \Delta exc_{3,t} \sim \mathcal{N}_2, \mathcal{N}_3(\mu_{\Delta exc}, \sigma^2_{\Delta exc})$. Formally,

$$\Delta exc_2 \sim \begin{cases} \mathcal{N}_2 \perp \mathcal{N}_3, & t < t_{EU} \\ \mathcal{N}_2 = \mathcal{N}_3, & t \geq t_{EU} \end{cases}$$

With these assumptions about the variables, our simulated data is generated with the following location-scale model:

$$\overline{\pi}_{i,t+1,t+2} = a_i + X_{it}'\beta + (\delta_i + X_{it}'\gamma)U_{it}, \quad U_{it} \sim \mathcal{N}(0,1) \tag{B1}$$

$$X_{i,t}' = (\Delta def_{i,t}, \pi_{i,t}, \Delta y_{i,t}, \Delta exc_{i,t}, \Delta oil_t) \tag{B2}$$

As before, conditional quantiles are then given by:

$$Q_\pi(\tau|X_{it}) = (\alpha_i + \delta_i q(\tau)) + X_{it}'\beta + X_{it}'\gamma q(\tau). \tag{B3}$$

[15] In principle, other variables could also be correlated across countries, but we set this aside for simplicity to examine the potential bias on one variable.

Since $U|X \sim \mathcal{N}(0,1)$, the conditional quantile of U is obtained using properties of the standard normal distribution. In particular,

$$Q_\pi(\tau|X_{it}) = (\alpha_i + \delta_i q(\tau)) + X_{it}'\beta + X_{it}'\gamma\Phi^{-1}(\tau) \tag{B4}$$

where $\Phi^{-1}(\cdot)$ denotes the inverse CDF of $U \sim N(0,1)$. We estimate the average effects of the regressors using ordinary least squares (OLS), and subsequently the quantile effects using the method of Machado and Santos Silva (2019).

In our simulation exercise, we are primarily concerned with the degree of bias on parameter estimates of $\Delta def_{i,t}$ as well as biases on $\pi_{i,t}$ due to inflation persistence and on $\Delta exc_{i,t}$ in the presence of a monetary union. Results from the Monte Carlo simulation are shown in Table B.1. The results demonstrate that both the regression quantile and OLS estimates recover the β^*s with reasonable accuracy (Figure B.1). Furthermore, we show that the noise resulting from inflation persistence and cross-correlation in the regressors lead to attenuation towards the average effects. In other words, the noises lead to an underestimation of the true degree of non-linearities in the effect of deficits and lagged inflation on the two-period-ahead average inflation. Applying these findings to our main results, this evidence suggests that our estimates likely underestimate the true extent of non-linearities in the real-world inflation distribution. This is particularly noteworthy for observations with above-median inflation, since it suggests that the risk of further inflation due to fiscal deficits may be even higher than estimated.

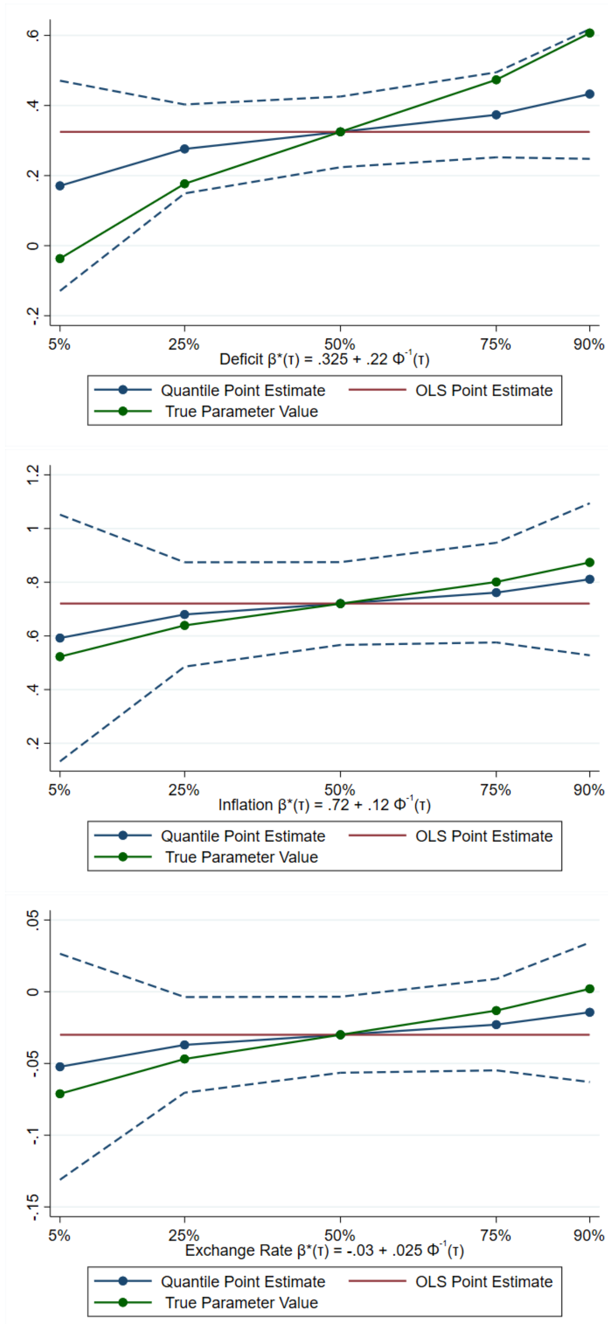

Figure B.1: **Estimated vs. "True" Parameter Values** We plot the estimated parameter values against what would be the true parameter values across quantiles based on the DGP described above. The plots suggest that the effects are overstated below the median quantile and understated above it, so the real-world non-linearities are likely understated due to noise in the sample. Importantly, the right tail inflation risk from fiscal deficits may be larger than it seems, based on our simulated results.

	Quantile (τ)	5%	25%	50%	75%	90%	OLS	$\beta^*(\tau)$
100 Reps	$\overline{\beta}_{\Delta def}$	0.24 (0.03,0.45)	0.30 (0.21,0.39)	0.33 (0.21,0.44)	0.35 (0.20,0.51)	0.39 (0.14,0.64)	0.33 (0.33,0.33)	$0.33 + 0.22\Phi^{-1}(\tau)$
	$\overline{\beta}_{\pi}$	0.65 (0.40,0.90)	0.70 (0.59,0.80)	0.72 (0.59,0.85)	0.74 (0.55,0.93)	0.77 (0.47,1.06)	0.72 (0.72,0.72)	$0.72 + 0.12\Phi^{-1}(\tau)$
	$\overline{\beta}_{\Delta exc}$	-0.04 (-0.09,0.01)	-0.03 (-0.05,-0.01)	-0.03 (-0.06,-0.003)	-0.03 (-0.06,0.01)	-0.02 (-0.08,0.04)	-0.03 (-0.03,-0.03)	$-0.03 + 0.025\Phi^{-1}(\tau)$
10000 Reps	$\overline{\beta}_{\Delta def}$	0.17 (-0.13,0.47)	0.28 (0.15,0.40)	0.33 (0.22,0.43)	0.37 (0.25,0.50)	0.43 (0.29,0.62)	0.33 (0.32,0.33)	$0.33 + 0.22\Phi^{-1}(\tau)$
	$\overline{\beta}_{\pi}$	0.59 (0.13,1.05)	0.68 (0.49,0.87)	0.72 (0.57,0.88)	0.76 (0.58,0.95)	0.81 (0.53,1.09)	0.72 (0.72,0.72)	$0.72 + 0.12\Phi^{-1}(\tau)$
	$\overline{\beta}_{\Delta exc}$	-0.05 (-0.13,0.03)	-0.04 (-0.07,-0.004)	-0.03 (-0.06,-0.003)	-0.02 (-0.06,0.01)	-0.01 (-0.06,0.03)	-0.03 (-0.03,-0.03)	$-0.03 + 0.025\Phi^{-1}(\tau)$
		N =840 (T = 40)						

Table B.1: **Monte Carlo Simulation Results**: In each column, we report average estimates of $\beta(\tau) = \beta + \gamma Q_{\overline{\pi}}(\tau|X)$ for simulations with 100 and 10,000 repetitions, respectively. The 90% confidence intervals, shown in parentheses, are computed using the average point estimate and average standard error from the repetitions in each simulation. The simulated results show that OLS estimates are robust to inflation persistence and cross-correlation in the regressors. Non-linearities are also reflected in the simulation.