Fiscal Fatigue: A Cross-Country Empirical Analysis

Aaron Zhong Fu Goh Zi Yun Chow

Central Bank of Malaysia, Malaysia

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Abstract

Amidst recent sovereign debt crises and the COVID-19 pandemic's global debt surge, the discourse on sovereign debt sustainability has resurfaced. The concept of fiscal fatigue, rooted in an endogenous limit as discussed by Ghosh (2013), addresses whether a limit exists beyond which mounting sovereign debt compromises solvency. This study investigates the prevalence of fiscal fatigue across countries by analyzing the linkage between lagged government debt and primary balance using a non-linear fiscal reaction function. Our findings suggest that there's no universal magic threshold. The threshold that was significant in the pooled ordinary least squares (POLS) model, is sensitive to sample selection, suggesting that only a few countries are driving headline fiscal fatigue trends. Nonetheless, fiscal fatigue could exist at different levels of debt for some countries, and such a limit tends to be higher for advanced economies. Therefore, the phenomenon of fiscal fatigue should be explored at the country-specific level to account for the unique underlying debt dynamics of each country.

Keywords: Fiscal fatigue, Debt limit, Fiscal reaction function, Non-linearity, Panel data
JEL Codes: E62, H63

†Any views expressed are solely the authors' and should not be taken to represent those of the Central Bank of Malaysia, or the Government of Malaysia.

1 Introduction

Amid occasional incidences of sovereign debt crises across advanced economies (AEs), and emerging economies (EMEs), the rapid increase in sovereign debt globally during the COVID-19 pandemic, have rekindled the debate surrounding sovereign debt sustainability. Is there a limit to how high sovereign debt can rise without compromising solvency? The concept of fiscal fatigue is premised on an endogenous limit, discussed in Ghosh et al. (2013). When debt is low, the relationship between primary balance and lagged debt is weak. At moderate levels of debt, primary balance rises with lagged debt with diminishing responsiveness. However, at high levels of debt beyond the endogenous debt limit, primary balance decreases sharply with lagged debt because the ability to increase primary balance cannot keep pace with rising debt. Fiscal fatigue occurs at this endogenous debt limit. In the policy reality, conceptually, there are two limits that determines how much a country can spend — (i) the statutory limit, and (ii) the endogenous limit. Distinguishing between these two limits can be challenging. The statutory limit is a self-imposed legal limit on debt, which may be set above, at, or below the endogenous limit. These limits tend to be country-specific, reflecting domestic circumstances, and often politico-economic history. Changes to statutory debt limits often require legislative approval. On the other hand, the endogenous limit is the point at which the country's debt relative to its GDP reaches a certain level, beyond which debt cannot be rolled over. Such a limit may remain unobserved in the data.

The paper aims to investigate whether fiscal fatigue exists. Should such a phenomenon exist, does it manifest homogeneously across countries? In other words, the primary goal of this study is to identify if such thresholds exist, using empirical fiscal reaction functions. Such thresholds hold significance for fiscal authorities in determining the appropriate juncture to necessitate fiscal consolidation. This study employs a static non-linear fiscal reaction function similar to Ghosh et al. (2013) to identify potential threshold across a panel of 18 countries (annual data spanning 1993 to 2022) that encompasses both AEs and EMEs. Homogeneity of fiscal fatigue is then explored with pooled ordinary least squares (POLS) model, country fixed effect (FE) model, and two-way fixed effect (TWFE) model. Country-specific ordinary least squares (COLS) with coefficients, essentially to mirror an unbalanced seemingly unrelated regression (SUR) model, is used to check for heterogeneity across countries. We find that there's no universal magic threshold, but fiscal fatigue could exist at different levels of debt for some countries (Checherita-Westphal & Žďárek 2017). Therefore, the phenomenon of fiscal fatigue should be explored at the country-specific level to account for the unique underlying debt dynamics of each country. In addition, our results also suggest that the endogenous debt limit tends to be higher for AEs. This is also consistent with the neighbouring literature on sovereign debt, which

considers default as a strategic default by governments (Arellano 2008).

The remainder of the paper proceeds as follows. In Section 2, the literature review is discussed. Section 3 presents the data used. In Section 4, we discuss the employed methodology in detail. In Section 5, we present the results. The final Section 6 concludes the paper.

2 Literature Review

The debt sustainability literature has theoretical underpinnings stemming from Bohn (1995, 1998). The essence of Bohn's sustainability test is to examine whether an increase in public debt leads to an increase in the primary balance after controlling for other factors such as the business cycle and inflation, by estimating a fiscal reaction function (FRF). Bohn showed that a positive response of the primary balance to lagged debt is a sufficient condition for the government to satisfy its intertemporal budget constraint, and thereby ensuring fiscal sustainability. However, Ghosh et al. (2013) proposes a stricter sustainability criterion — public debt should converge to some finite proportion of GDP. As such, a sufficient condition for this stricter condition is that the responsiveness of the primary balance should be greater than interest rate-growth rate differential.[1] This stricter criterion also rules out an ever-increasing debt-to-GDP ratio which leads to the need for primary surplus to eventually exceed GDP. The empirical exercise done here is based on this theoretical framework from Ghosh et al. (2013).

The FRF literature has evolved to focus more on a non-linear fiscal reaction specification (Checherita-Westphal & Žďárek 2017, Everaert & Jansen 2018). A polynomial functional form[2] allows us to test if fiscal fatigue is an empirical regularity. However, the findings from the fiscal fatigue literature across countries remain mixed. There are evidence for homogeneous fiscal fatigue from Medeiros (2012), Ghosh et al. (2013), Fournier & Fall (2015), but the specific threshold identified is not consistent and the results seem to be rather sensitive to sample composition and estimation approach. In contrast, there are also studies that found evidence for heterogeneous fiscal fatigue, where the debt threshold is found to be country-specific (Baldi & Staehr 2016, Everaert & Jansen 2018, Icaza 2018). Moreover, there are studies that found no significant evidence for fiscal fatigue as well (Fatás & Mihov 2010, Zedda et al. 2011, Legrenzi & Milas 2013). Although some of these studies have the same underlying countries, the empirical findings are diverse. It is also worth noting that these studies tend to focus more on the Euro area and other AEs.

[1] If primary balance reacts to rising debt stronger than this differential, then primary adjustment will offset the autonomous dynamics and the debt ratio will converge (Ghosh et al. 2013)

[2] Quadratic or cubic

This paper seeks to explore the existence of fiscal fatigue by studying the general relationship between lagged government debt and primary balance; and identify whether a general threshold exist between these two factors while controlling for other factors. Furthermore, it aims to assess whether this phenomenon demonstrates homogeneity or heterogeneity. The research extends its analysis to a diverse range of countries, encompassing both AEs and EMEs. Our findings suggest evidence for heterogeneous fiscal fatigue in some countries. Therefore, the phenomenon of fiscal fatigue should be explored at the country-specific level to account for the unique underlying debt dynamics of each country.

3 Data

Annual unbalanced panel data from 18 countries are used over the period of 1993 - 2022. These include a mix of AEs and EMEs, covering various regions such as the Americas (Brazil, Chile, Colombia, United States), Asia (China, India, Indonesia, Japan, Malaysia, Philippines, South Korea, Thailand), and Europe (France, Germany, Italy, Spain, Turkey, United Kingdom). These countries were chosen due to data availability considerations, and economic prominence within AEs and EMEs. Adding or removing more countries should not affect the key results from this paper. However, some countries only have complete data starting later than 1993. Annual data are used for primarily two reasons — (1) within-year fiscal balances are prone to discretionary spending choices that are administrative or political in nature, rather than a reflection of fiscal space or other economic constraints, and (2) limited availability of higher-frequency data in most countries. The data set is compiled by CEIC from national authorities and the IMF.

3.1 Variables

The variables used in this study are PB, DEBT, RGDP, CA, CPI, TRADE, OLDAGE, FUEL and NONFUEL, where:

- PB = cyclically adjusted primary balance (% of potential GDP) from IMF
- DEBT = gross government debt (% of GDP)
- RGDP = real GDP (year-on-year growth)
- CA = current account balance (% of GDP)

- INF = Inflation (year-on-year growth of consumer price index (CPI))
- TRADE = total trade of goods and services (% of GDP)
- OLDAGE = old-age dependency ratio
- FUEL = fuel price index (year-on-year growth) from IMF
- NONFUEL = non-fuel price index (year-on-year growth) from IMF

3.2 Descriptive analysis

3.2.1 Stylised fact #1

Plotting the data of primary balance against first lagged debt by country (Figure 1), reveals that the debt-to-GDP ratios (the horizontal axis) tend to be highly static over time, even if fiscal balance (the vertical axis) fluctuates wildly. In addition, the upper tail of debt-to-GDP ratios are mostly only driven Italy, Japan and the US.

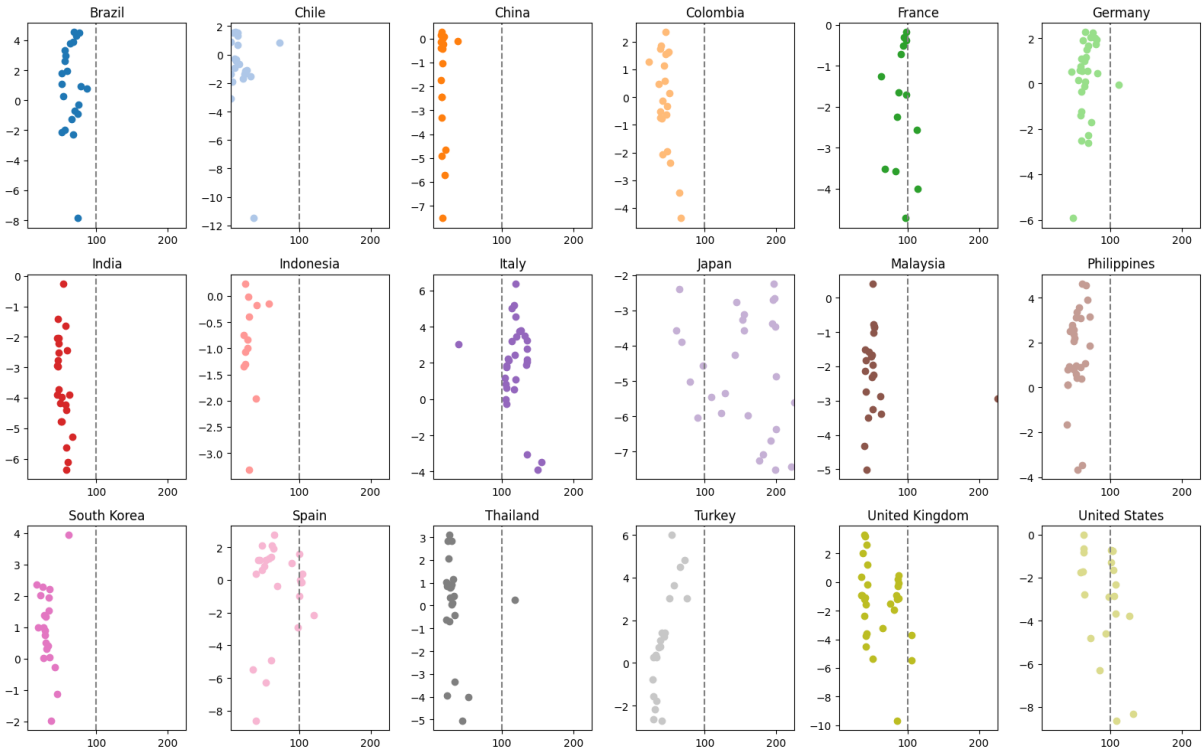


Figure 1: Cyclically adjusted primary balance vs first lagged debt by country

3.2.2 Stylised fact #2

Plotting the pooled data of primary balance against first lagged debt (Figure 2), indicates a weak relationship between cyclically adjusted primary balance and first lagged debt. However, there are also some indication of a negative relationship with primary balance at higher levels of debt for Japan and the US.

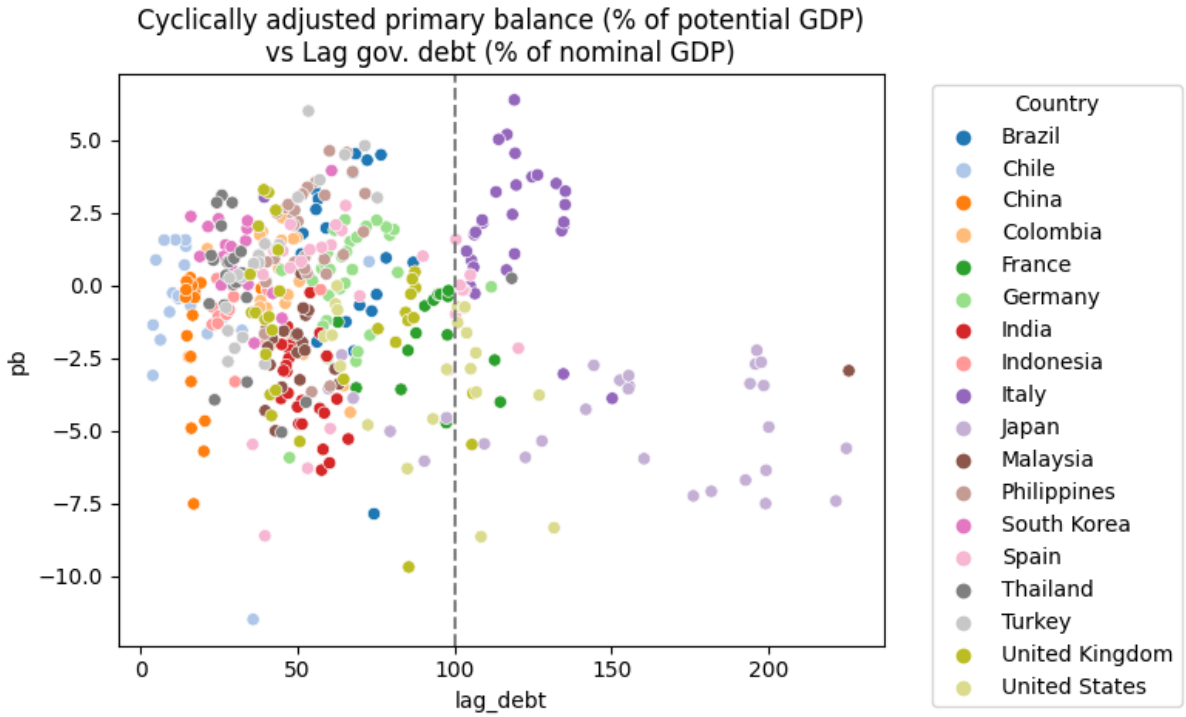


Figure 2: Pooled cyclically adjusted primary balance vs first lagged debt

4 Methodology

This paper adopts a similar specification of the static non-linear fiscal reaction function from Ghosh et al. (2013) with a slightly different set of controls due to data availability constraints, as described in (1).

$$pb_{i,t} = \alpha_i + \sum_{j=1}^{3} \beta_j debt_{i,t-1}^{j} + \gamma y_{i,t} + \lambda X_{i,t} + \epsilon_{i,t} \tag{1}$$

where for country i at time t, $pb_{i,t}$ is the cyclically adjusted primary balance (% of potential GDP), $\sum_{j=1}^{3} \beta_j debt_{i,t-1}^{j}$ is the cubic polynomial of lagged gross government debt (% of GDP), $y_{i,t}$ is the year-on-year growth of real GDP, $X_{i,t}$ is a vector of control variables[3] following the literature (Ghosh et al. 2013, Everaert & Jansen 2018, Checherita-Westphal & Žďárek 2017), α_i is the country fixed effect and $\epsilon_{i,t}$ is the error term. $y_{i,t}$ is used as a proxy for business cycle fluctuations. The rationale behind the selection of our controls is as follows. CA is used to control for cross-country spillovers. TRADE is included to control for the sensitivity of countries' PB to unforeseen international economic shocks. INF, FUEL & NONFUEL are used to control for the effects of inflation. OLDAGE is used to account for the country's demographic structure.

In terms of estimation strategy, pooled ordinary least squares (POLS) offers a baseline. However, the lagged debt terms are correlated with unobserved country-specific determinants of the primary balance, as countries tend to have lower debt levels if they are able to generate a higher primary balance due to favourable fixed effects. As such, country fixed effect (FE) is adopted next to deal with this endogeneity bias. However, FE models in a dynamic panel model setting is susceptible to the Nickell (1981) bias for finite T and $N \to \infty$. Nonetheless, according to the 'rule of thumb' based on Bond (2002), which states that for cases where T is larger than 20, the potential bias of the FE estimator should be negligible. Furthermore, a two-way fixed effect (TWFE) model is adopted to account for time-specific shocks such as the Global Financial Crisis period that could adversely impact primary balance. Finally, we ran country-specific ordinary least squares (COLS) to test for heterogeneity of fiscal fatigue. Although a seemingly unrelated regression (SUR) could be more efficient when there are inter-dependencies in the system in the form of shared time-series patterns or unobserved factors; running it in an unbalanced panel setting might not be suitable due to additional assumptions required

[3]Vector of control variables include all other variables mentioned in Section 3. CA = current account balance (% of GDP), INF = Inflation (year-on-year growth of CPI), TRADE = total trade of goods and services (% of GDP), OLDAGE = old-age dependency ratio, FUEL = fuel price index (year-on-year growth), and NONFUEL = non-fuel price index (year-on-year growth)

to handle missing data patterns and varying observation counts. All models adopted an $AR(1)$ error structure to account for persistence in the error term.

4.1 Robustness checks

Robustness check is performed by adding a crisis dummy and $pb_{i,t-1}$ to (1) as described in (2).

$$pb_{i,t} = \alpha_i + \sum_{j=1}^{3} \beta_j debt_{i,t-1}^{j} + \gamma y_{i,t} + \lambda X_{i,t} + \mu \mathrm{pb}_{i,t-1} + Z_1 crisis + Z_2 crisis * debt_{i,t} + \epsilon_{i,t} \quad (2)$$

The first check is done by including a crisis dummy and an interaction term between crisis dummy and debt for POLS and FE, but only adding the interaction term for TWFE. $Crisis = 1$ when $t = 1997,\ 1998,\ 2007,\ 2008,\ 2009$ to account for both the Asian Financial Crisis and Global Financial Crisis. The second check is done by adopting a dynamic panel specification with an additional $pb_{i,t-1}$, to allow for sluggishness in fiscal policy response to economic conditions. The third check is done by running unadjusted models without controls to test if results are robust to selection of controls.

5 Results

5.1 Panel analysis

	Dependent variable: primary balance					
	(1) POLS	(2) FE	(3) TWFE	(4) POLS	(5) FE	(6) TWFE
$DEBT_{t-1}$	-0.038**	0.028	0.051	-0.028***	0.005	0.043
	(0.018)	(0.051)	(0.037)	(0.009)	(0.063)	(0.047)
$DEBT^2_{t-1}$	0.001**	-3×10^{-4}	-4×10^{-4}	4×10^{-4}**	1×10^{-4}	-2×10^{-4}
	(0.000)	(0.001)	(3×10^{-4})	(0.000)	(0.001)	(4×10^{-4})
$DEBT^3_{t-1}$	-2.4×10^{-6}***	1.27×10^{-6}	9.02×10^{-7}	-1.99×10^{-6}**	2.44×10^{-7}	3.96×10^{-7}
	(7.8×10^{-7})	(1.4×10^{-6})	(8.7×10^{-7})	(6.5×10^{-7})	(1.5×10^{-6})	(1.2×10^{-6})
$RGDP_t$	0.062	0.230***	0.097	-	-	-
	(0.042)	(0.055)	(0.063)			
CA_t	0.075*	0.190***	0.146***	-	-	-
	(0.040)	(0.054)	(0.052)			
INF_t	0.113***	0.095***	0.085	-	-	-
	(0.032)	(0.030)	(0.033)			
$FUEL_t$	0.006	0.002	-	-	-	-
	(0.007)	(0.004)				
$NONFUEL_t$	-0.048***	-0.048***	-	-	-	-
	(0.016)	(0.014)				
$TRADE_t$	-3×10^{-4}	-0.018	-0.029	-	-	-
	(0.005)	(0.021)	(0.023)			
$OLDAGE_t$	-0.022	-0.175**	0.068	-	-	-
	(0.018)	(0.071)	(0.096)			
Observations	416	416	416	416	416	416
R^2	0.199	0.249	0.111	0.149	0.008	0.003
Note:						*p<0.1; **p<0.05; ***p<0.01

Table 1: Model estimates of (1) POLS, (2) FE, (3) TWFE; and unadjusted models without controls (4) POLS, (5) FE, (6) TWFE

The fiscal fatigue proposition rests on the existence of an endogenous limit; where the positive response of primary balance to lagged debt suddenly turns negative at the limit. This can be captured by $\beta_3 < 0$ in a cubic specification, or $\beta_2 < 0$ and $\beta_3 = 0$ in a quadratic specification. Only POLS suggests that fiscal fatigue proposition holds, while both the FE and TWFE[4] models suggest otherwise. Based on the stylised facts in Section 3, the POLS results could be driven only by a few countries. At best, there could be evidence for heterogeneous threshold for fiscal fatigue, rather than a universal

[4]FUEL & NONFUEL are removed from TWFE because they are perfectly correlated with time fixed-effect across countries; since the series remain the same across countries over time.

threshold. This is consistent with our model estimates that the threshold is sensitive to sample selection, as shown in Figure 3 & 4[5] below, which plot the fitted cyclically-adjusted primary balance. After removing Italy, Japan and the US[6], the coefficients on lagged debt are no longer statistically significant at the 5% level, and the estimated threshold fell from approximately 100% to 80%.

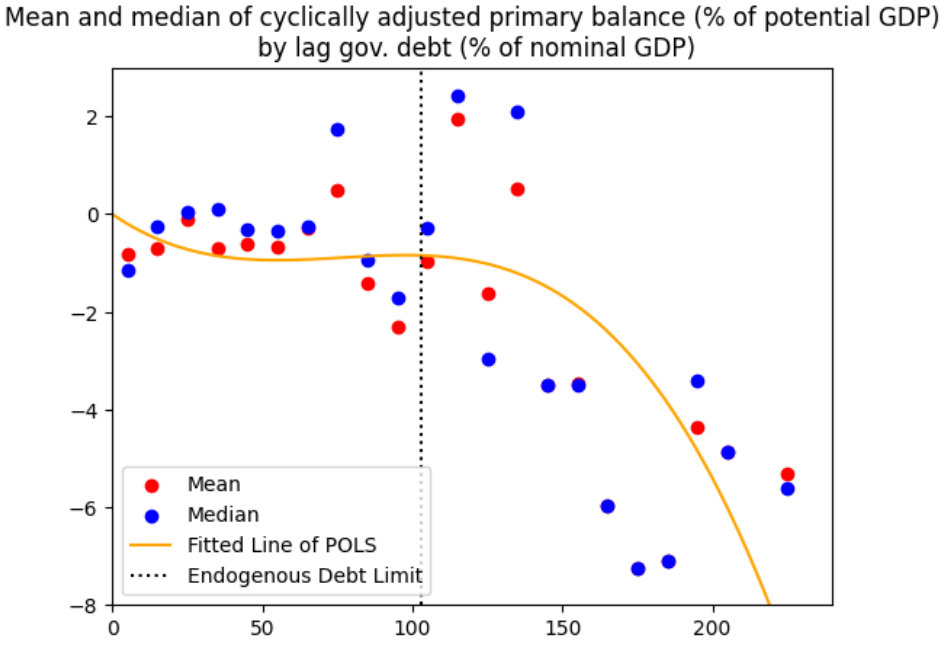


Figure 3: Fitted POLS: Full sample

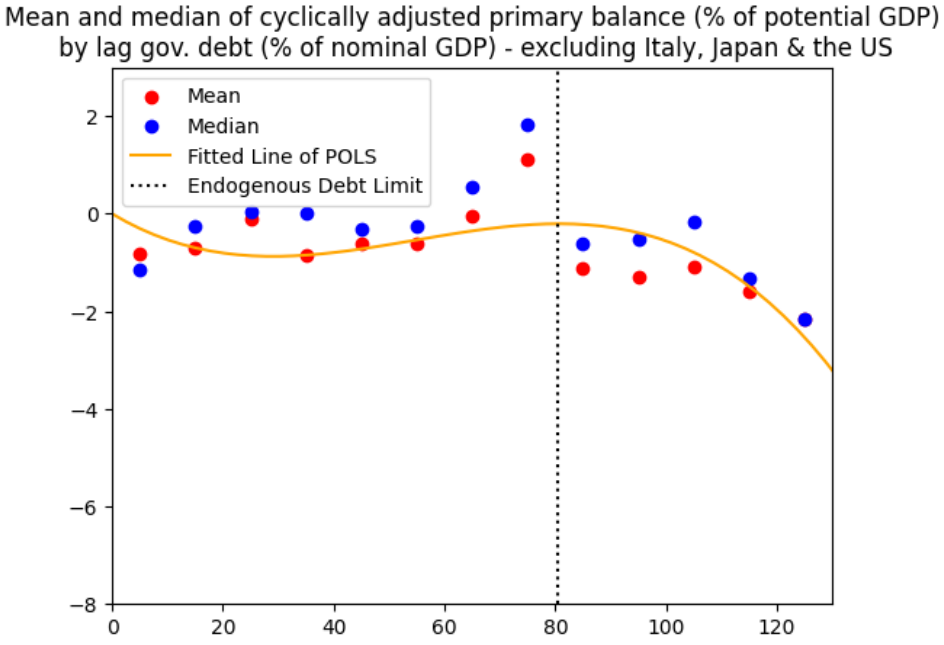


Figure 4: Fitted POLS: Excluding Italy, Japan and the US

[5]Mean and median refer to bucketed mean and median of relevant data set within a 10ppt debt range
[6]The countries that mainly contribute to more than 100% debt-to-GDP ratio in our panel data

Rerunning the POLS with only AEs and EMEs respectively also suggest that fiscal fatigue is only present in some countries. From Table 2, only (1) displays evidence for fiscal fatigue but not (2). In the case of (1), the estimated threshold is approximately 174%, suggesting that AEs have a higher threshold than EMEs. This is evident as the estimated threshold decreases with the inclusion of EMEs in the full sample (as shown in Figure 3). It is also worth noting that the results from Table 2 provide indivative trends across AEs and EMEs but may still obscure important country-specific variations within the samples.

	Dependent variable: primary balance	
	(1)	(2)
	AEs	EMEs
$DEBT_{t-1}$	-0.0504	0.1872**
	(0.034)	(0.079)
$DEBT^2_{t-1}$	0.0007**	-0.0061**
	(0)	(0.002)
$DEBT^3_{t-1}$	-2.13×10^{-6}**	5.30×10^{-5}**
	1.05×10^{-6}	1.93×10^{-5}
$RGDP_t$	0.258***	-0.0146
	(0.08)	(0.052)
CA_t	0.0977	0.0186
	(0.066)	(0.05)
INF_t	0.089	0.0479*
	(0.149)	(0.025)
$FUEL_t$	0.0017	-0.002
	(0.01)	(0.009)
$NONFUEL_t$	-0.0918***	0.0042
	(0.022)	(0.02)
$TRADE_t$	0.0902***	-0.0031
	(0.017)	(0.005)
$OLDAGE_t$	-0.1969***	-0.154***
	(0.053)	(0.047)
Observations	416	416
R^2	0.199	0.249
Note:	*p<0.1; **p<0.05; ***p<0.01	

Table 2: Model estimates of POLS using (1) AEs sample & (2) EMEs sample

Coefficients of RGDP have the expected positive sign across most models because economic booms should improve fiscal balances, through a combination of a faster expansion in GDP, and faster growth in tax receipts. The positive CA coefficients across models reflect the twin deficit hypothesis, where a fiscal deficit is correlated with a current account deficit and vice-versa. The positive INF coefficients supports the bracket-creep

effect hypothesis[7]. The negative coefficients of OLDAGE is also expected given a reduction in tax revenue due to a smaller labour force. Hence, the estimated coefficients of other determinants included in the fiscal reaction function are broadly consistent with the literature.

5.2 Country-specific analysis

Country-specific OLS with a cubic specification reveals large cross-country variation. This is consistent with the findings in the fitted data from the pooled model, where a few countries drive the overall FRF. In Figure 5, only the yellow-highlighted countries (mostly AEs) have significant and correct coefficient signs of lagged debt terms to support the fiscal fatigue hypothesis, which are Colombia, France, Japan, Spain, the UK, and the US.

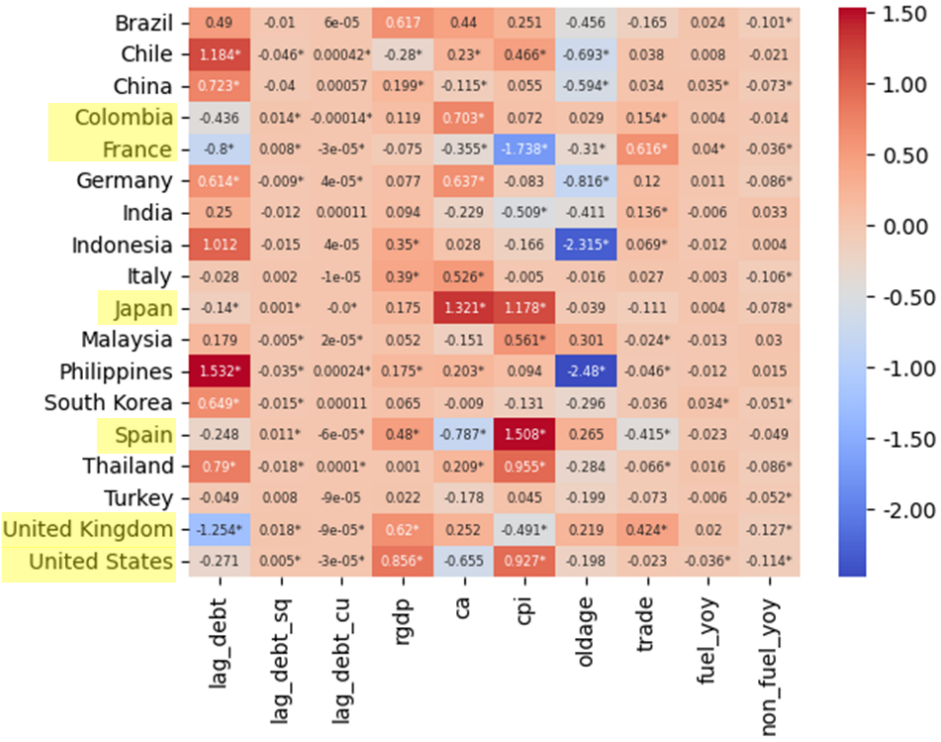


Figure 5: Heatmap: Country-specfic OLS (Cubic)

[7]Under a progressive tax system, government revenues tend to rise faster than inflation when there is no automatic indexation of tax brackets

Country-specific OLS using a quadratic specification is also adopted as sensitivity analysis. In Figure 6, only the green-highlighted countries (balanced mix of AEs and EMEs) have significant and correct coefficient signs of lagged debt terms to support the fiscal fatigue hypothesis.

Plotting out the specific thresholds at which fiscal fatigue sets in, shown in Figure 7a & 7b, allows us to visualise how these thresholds differ by countries. The thresholds for AEs are higher than 80% of debt-to-GDP ratio except for the UK. This is because UK generally has lower debt than other AEs. The results are fairly consistent with previous studies that found that the threshold is greater than 100% for AEs (Ghosh et al. 2013, Medeiros 2012, Fournier & Fall 2015). On the other hand, EMEs tend to have estimated thresholds of less than 80% of debt-to-GDP ratio, consistent with estimates for Latin American economies (Lozano-Espitia & Julio-Román 2020). Our estimates of Indonesia's threshold at 41% and the Philippines' at 57% of GDP are also broadly consistent with Widiastuti et al. (2023) at 50% and Cevik (2019) at 60% respectively.

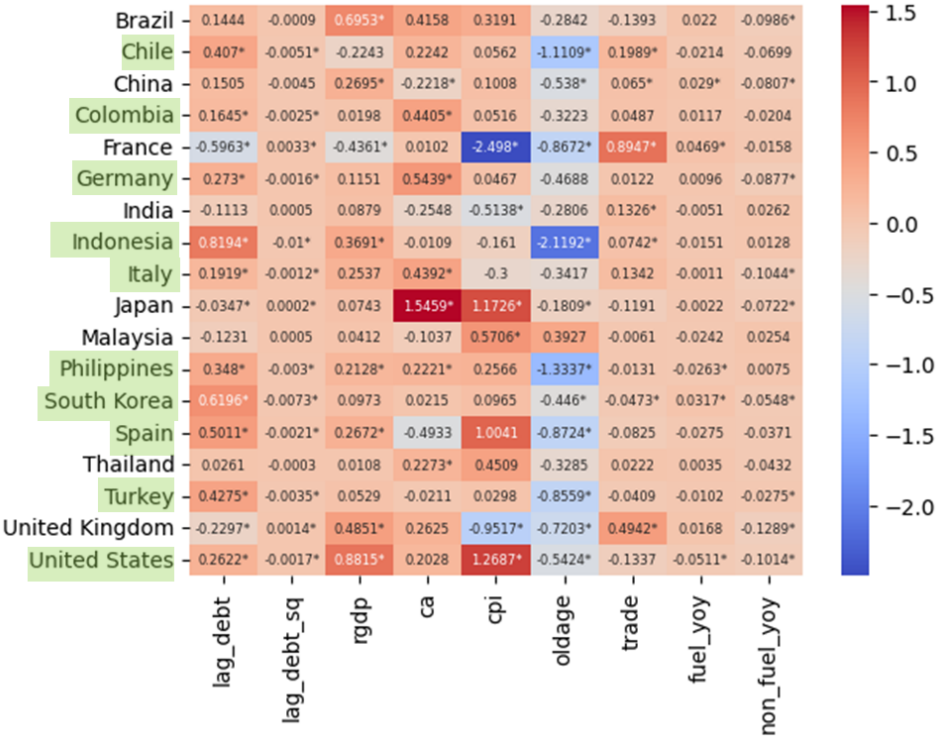
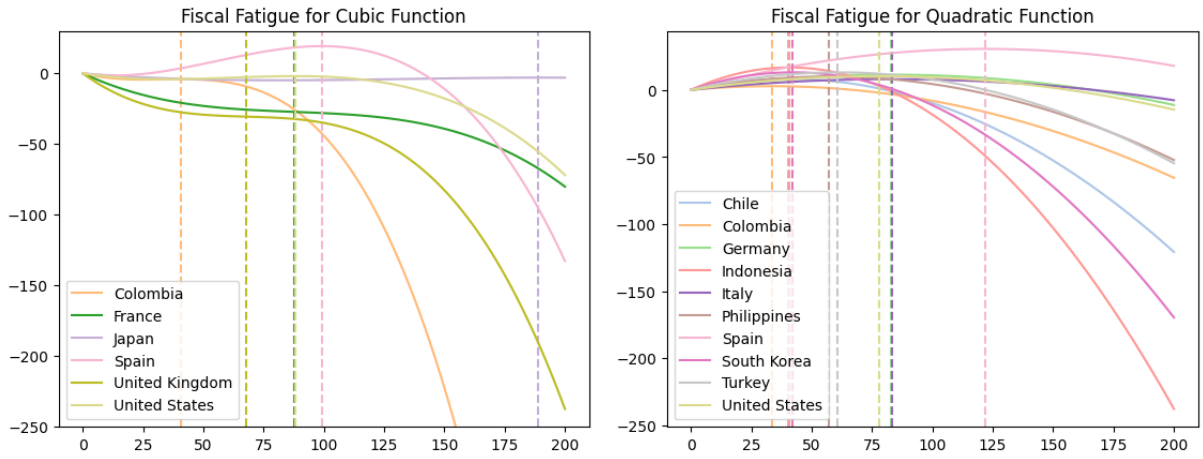


Figure 6: Heatmap: Country-specific OLS (Quadratic)



(a) Cubic Function **(b)** Quadratic Function

Figure 7: Fiscal fatigue based on country-specific OLS

Zooming into the specific threshold for each country in Figure 7a and 7b as shown in Table 3, suggest that even if some countries exceed the estimated threshold, the fiscal fatigue phenomenon does not necessarily occur. Table 3 shows that only countries highlighted in green did not exceed our estimated threshold at the beginning of the COVID-19 pandemic in 2019. Although some countries exceeded our estimated threshold, Figure 8 shows that none of these countries experienced a sharp and persistent decline in primary balance after exceeding the threshold in 2019, even in the midst of the COVID-19 pandemic, where the primary balance is expected to worsen due to lockdowns and increased government spending on COVID-19 related expenses (most of these countries experienced a 'v-shaped' recovery in primary balance post-2019 instead). As such, even if there is evidence for heterogeneous fiscal fatigue for some countries, exceeding the estimated threshold does not always lead to a sharp and persistent decline in primary balance. This could be due to multiple reasons: (1) estimated thresholds may be downward biased if the true threshold was never reached in the data, (2) country-specific estimation requires a more careful treatment of country-specific determinants that may not be captured in our generic fiscal reaction function. Thus, future research that seeks to identify the precise threshold for any specific country should take into consideration the unique underlying debt dynamics of the country.

Function	Country	Threshold	Debt-to-GDP (2019 – start of COVID-19 pandemic)
Cubic	Colombia	40.6	51.9
	France	87.5	97.4
	Japan	188.9	199.1
	Spain	99.1	98.2
	United Kingdom	68.0	85.5
	United States	88.1	108.5
Quadratic	Chile	40.2	26.7
	Colombia	33.4	51.9
	Germany	82.9	59.6
	Indonesia	40.6	30.2
	Italy	83.1	134.7
	Philippines	57.1	39.6
	Spain	121.7	98.2
	South Korea	42.0	36.3
	Turkey	60.9	32.6
	United States	78.1	108.5

Table 3: Threshold estimates from COLS and debt-to-GDP ratio at the start of COVID-19 pandemic

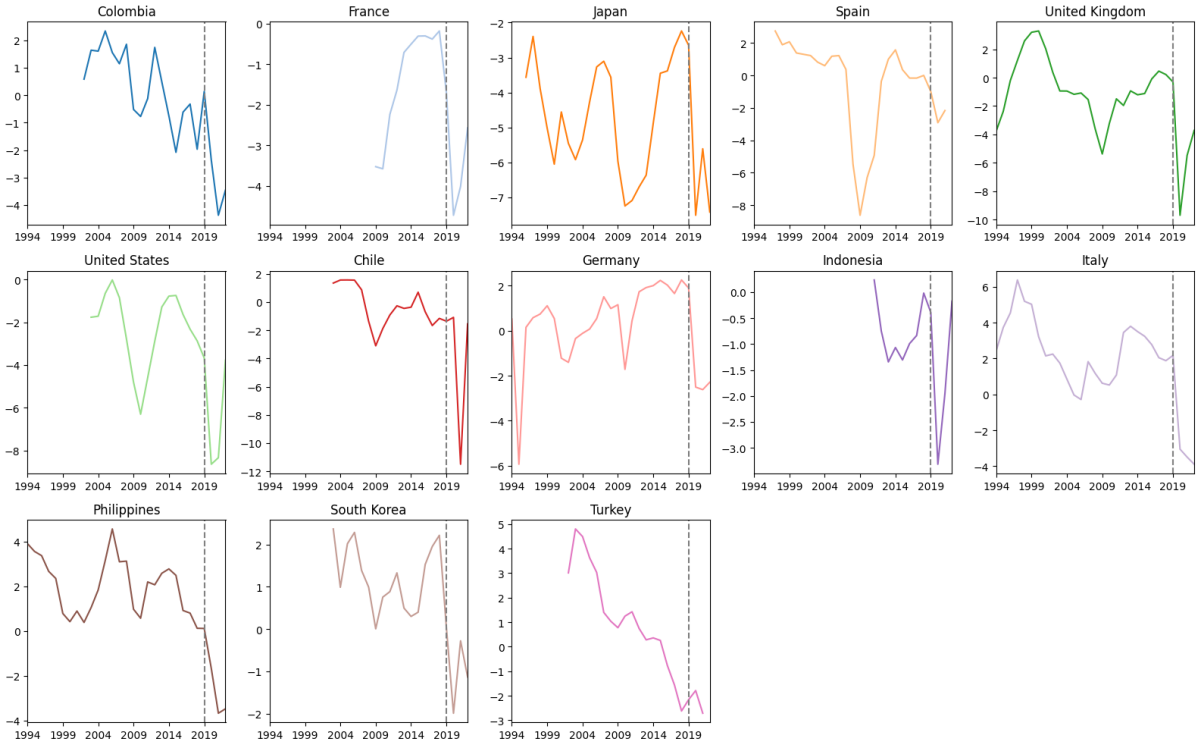


Figure 8: Annual cyclically adjusted primary balance by country with evidence for fiscal fatigue

5.3 Robustness checks

The first robustness check of including crisis dummies found mixed estimates for both Z_1 & Z_2, but both are not statistically significant. The results of the other coefficients remain broadly similar, even after changing the years included in the dummy. Although μ is statistically significant and positive as expected in the second robustness check of adding $pb_{i,t-1}$, there are no other substantial changes in results. As such, we have decided to retain the original model as $AR(1)$ error structure seems to be sufficient in accounting for persistence in the error term. The third robustness check suggest that our key findings are robust to selection of controls. Although coefficient estimates are different, the direction and significance remain the same across models.

6 Conclusion

This paper investigated the presence, and prevalence of fiscal fatigue across a panel of AEs and EMEs by employing a similar specification of non-linear fiscal reaction function from Ghosh et al. (2013), with a slightly different set of controls. The result showed that there's no universal magic threshold. The threshold that was significant in POLS, is sensitive to sample selection, suggesting that only a few countries are driving headline fiscal fatigue trends. Results from COLS also suggest that the threshold is sensitive to FRF specification. Nonetheless, fiscal fatigue could exist at different levels of debt for some countries, and such a limit tends to be higher for AEs than for EMEs. Our country-specific estimations suggest that even if some countries exceed the estimated threshold, the fiscal fatigue phenomenon does not necessarily take place. Therefore, the phenomenon of fiscal fatigue should be explored at the country-specific level to account for unique heterogeneity more precisely to ensure unbiasedness. Robustness checks were also implemented, specifically the inclusion of lagged values of cyclically adjusted primary balance and interacted crisis dummy variables to the non-linear fiscal reaction function. Future research should investigate the determinants of the heterogeneous response, explore the impact and duration of fiscal consolidation or liberalisation on the FRF, and study how such fiscal stance could affect fiscal fatigue.

Data and replication statement All data sources used in this study are open access. Data vintages and codes are available at `https://github.com/Aarongzf/fiscal-fatigue`

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