Fiscal Fatigue: A Cross-Country Empirical Analysis

Aaron Zhong Fu Goh Zi Yun Chow

Central Bank of Malaysia, Malaysia

May 3, 2023

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.

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). In addition, our results also suggest that the endogenous debt limit tends to be higher for AEs.

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 remains 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 evidence remains vastly different. It is also worth noting that these studies tend to focus more on the Euro area and other AEs.

This paper seeks to explore the existence of fiscal fatigue by exploring 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.

[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

3 Data

Annual unbalanced panel data from 18 countries are used over the period 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). However, some countries only have complete data starting later than 1993. Annual data is 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
- CA = current account balance (% of GDP)
- CPI = consumer price index (year-on-year difference)
- TRADE = total trade of goods and services (% of GDP)
- OLDAGE = old-age dependency ratio
- FUEL = fuel price index (year-on-year difference) from IMF
- NONFUEL = non-fuel price index (year-on-year difference) from IMF

3.2 Descriptive analysis

Plotting the pooled data of primary balance against first lagged debt (Figure 1), indicates a weak relationship between cyclically adjusted primary balance (the vertical axis) and first lagged debt (the horizontal axis). However, there are also some indication of a negative relationship with primary balance at higher levels of debt for Japan and the US. At an individual country level, the debt-to-GDP ratios tend to be highly static over time for most countries, even if fiscal balance fluctuates wildly. This suggests that the upper tail of debt-to-GDP ratios are mostly only driven Italy, Japan and the US.

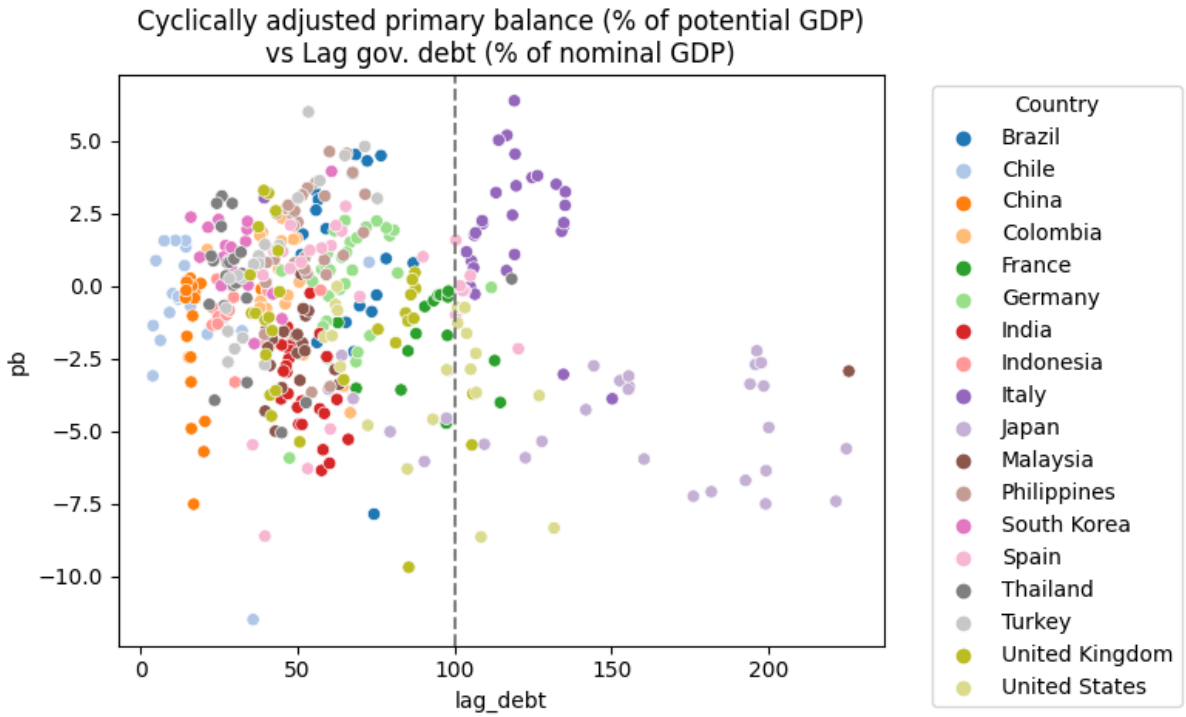


Figure 1: Pooled cyclically adjusted primary balance vs first lagged debt

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 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's PB to unforeseen international economic shocks. CPI, FUEL & NONFUEL are used to control for the effects of inflation. OLDAGE is used to account for the country's demographic structure.

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

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 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 or $pb_{i,t-1}$ 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 and additional $pb_{i,t-1}$, to allow for sluggishness in fiscal policy response to economic conditions.

5 Results

5.1 Pooled analysis

	Dependent variable: primary balance		
	(1)	(2)	(3)
$DEBT_{t-1}$	-0.038^{**}	0.028	0.051
	(0.018)	(0.051)	(0.037)
$DEBT^2_{t-1}$	0.001^{**}	-3×10^{-4}	-4×10^{-4}
	(0.000)	(0.001)	(3×10^{-4})
$DEBT^3_{t-1}$	$-2.442\times10^{-6***}$	1.265×10^{-6}	9.023×10^{-7}
	(7.76×10^{-7})	(1.362×10^{-6})	(8.727×10^{-7})
$RGDP_t$	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)
CPI_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
R^2	0.199	0.249	0.111

Note: *p<0.1; **p<0.05; ***p<0.01

Table 1: Model estimates of (1) POLS, (2) FE & (3) TWFE

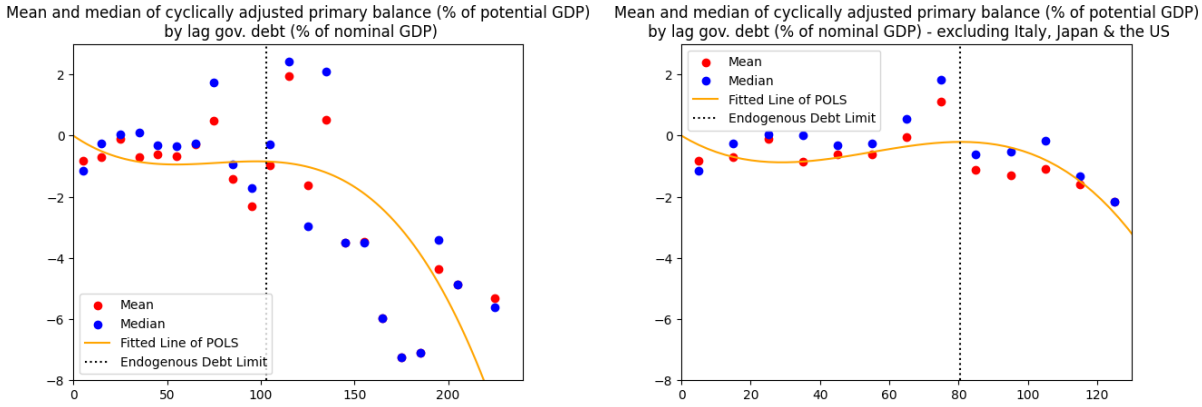
The fiscal fatigue proposition rests on the existence of an endogenous limit; where the positive response of primary balance to lagged debt suddenly turns negative at the limit. This can be captured by $\beta_3 < 0$ in a cubic specification, or $\beta_2 < 0$ and $\beta_3 = 0$ in a quadratic specification. 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 threshold. This is consistent with our model estimates that the threshold is sensitive to sample selection, as shown in Figure 2a & 2b[5] below, which plots 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

[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.

[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

fell from approximately 100% to 80%.



(a) Full sample **(b)** Excluding Italy, Japan and the US

Figure 2: Fitted POLS

Coefficients of RGDP have the expected positive sign across all 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 CPI 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

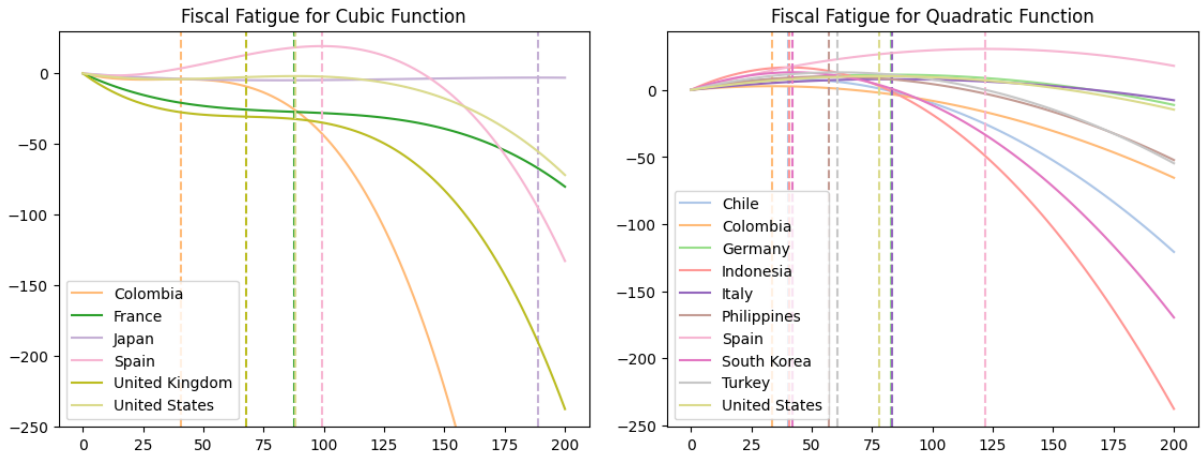
Country-specific OLS with a cubic specification reveals large cross-country variation. This is consistent with the findings in the fitted data from the pooled model, where a few countries drive the overall FRF. Only Colombia, France, Japan, Spain, the UK, and the US have significant and correct coefficient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

Country-specific OLS using a quadratic specification is then adopted as sensitivity analysis. Chile, Colombia, Germany, Indonedia, Italy, Philippines, South Korea, Spain, Turkey and the US (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 3a & 3b, 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,

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

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) 60% respectively.



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

Figure 3: Fiscal fatigue based on country-specific OLS

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.

6 Conclusion

This paper investigated the presence, and prevalence of fiscal fatigue across a panel of AEs and EMEs 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. Robustness checks were also implemented, specifically the inclusion of lagged values of cyclically adjusted primary balance, and interacted crisis dummy variables are added 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`

Acknowledgements This paper has benefited from the following individuals for their critical review and feedback.

- Eilyn Yee Lin Chong, Central Bank of Malaysia, Malaysia
- Jing Lian Suah, Central Bank of Malaysia, Malaysia

References

Baldi, G. & Staehr, K. (2016), 'The european debt crisis and fiscal reactions in europe 2000–2014', *International Economics and Economic Policy* **13**, 297–317.

Bohn, H. (1995), 'The sustainability of budget deficits in a stochastic economy', *Journal of Money, Credit and Banking* **27**(1), 257–271.

Bohn, H. (1998), 'The behavior of us public debt and deficits', *the Quarterly Journal of economics* **113**(3), 949–963.

Bond, S. R. (2002), 'Dynamic panel data models: a guide to micro data methods and practice', *Portuguese economic journal* **1**, 141–162.

Cevik, S. (2019), 'Anchor me: the benefits and challenges of fiscal responsibility', *Asian-Pacific Economic Literature* **33**(1), 33–47.

Checherita-Westphal, C. & Žďárek, V. (2017), Fiscal reaction function and fiscal fatigue: evidence for the euro area, Technical report, ECB Working Paper.

European Economy. Public Finances in EMU-2011. European Economy 2011.3 (2011). **URL:** *http://aei.pitt.edu/92041/*

Everaert, G. & Jansen, S. (2018), 'On the estimation of panel fiscal reaction functions: Heterogeneity or fiscal fatigue?', *Economic Modelling* **70**, 87–96.

Fatás, A. & Mihov, I. (2010), The euro and fiscal policy, *in* 'Europe and the Euro', University of Chicago Press, pp. 287–324.

Fournier, J.-M. & Fall, F. (2015), 'Limits to government debt sustainability'.

Ghosh, A. R., Kim, J. I., Mendoza, E. G., Ostry, J. D. & Qureshi, M. S. (2013), 'Fiscal fatigue, fiscal space and debt sustainability in advanced economies', *The Economic Journal* **123**(566), F4–F30.

Icaza, V. E. (2018), 'Fiscal fatigue and debt sustainability: Empirical evidence from the eurozone 1980–2013', *Cuadernos de Economía* **41**(115), 69–78.

Legrenzi, G. & Milas, C. (2013), 'Modelling the fiscal reaction functions of the gips based on state-varying thresholds', *Economics Letters* **121**(3), 384–389.

Lozano-Espitia, I. & Julio-Román, J. M. (2020), 'Debt limits and fiscal space for some latin american economies', *Latin American Journal of Central Banking* **1**(1-4), 100006.

Medeiros, J. (2012), Stochastic debt simulation using var models and a panel fiscal reaction function–results for a selected number of countries, Technical report, Directorate General Economic and Financial Affairs (DG ECFIN), European ….

Nickell, S. (1981), 'Biases in dynamic models with fixed effects', *Econometrica: Journal of the econometric society* pp. 1417–1426.

Widiastuti, N., Fitrady, A. & Widodo, T. (2023), 'Assessing fiscal sustainability in indonesia', *Jurnal Ekonomi dan Studi Pembangunan* **15**(1), 101–123.

Zedda, S., Campolongo, F., Cariboni, J., Marchesi, M., Petracco, M., Salto, M. et al. (2011), 'Public finances in emu', *EUROPEAN ECONOMY* **3**, 1–226.