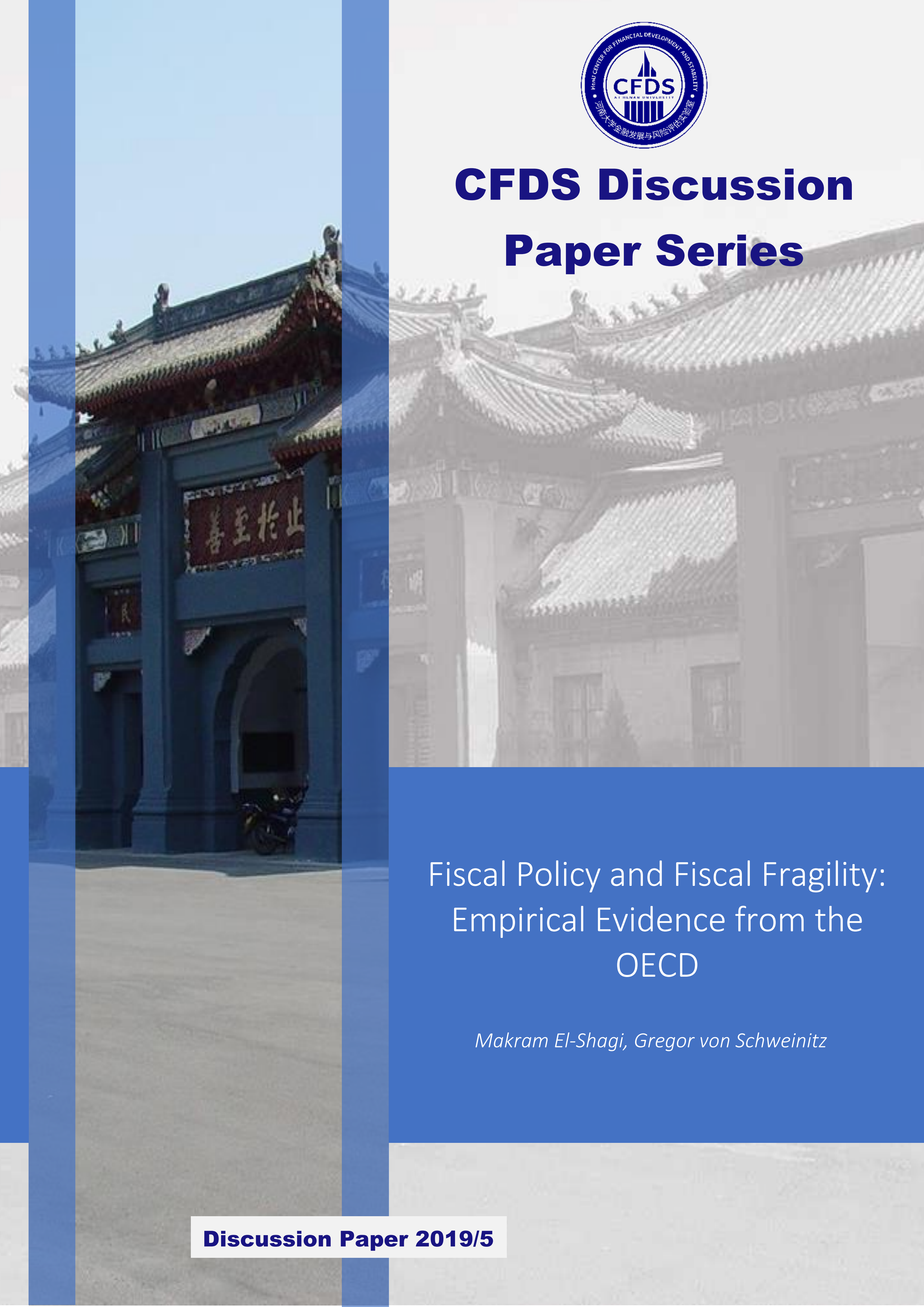

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Discussion Paper 2019/5

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Fiscal policy and fiscal fragility: Empirical evidence from the OECD

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This version: June 6, 2019

Abstract

In this paper, we use local projections to investigate the impact of consolidation shocks on GDP growth, conditional on the fragility of government finances. Based on a database of fiscal plans in OECD countries, we show that spending shocks are less detrimental than tax-based consolidation. In times of fiscal fragility, our results indicate strongly that governments should consolidate through surprise policy changes rather than announcements of consolidation at a later horizon.

Keywords: Fiscal multipliers; fiscal consolidation; local projections
JEL-Classification: E62; H63

*Corresponding author. Email: elshagi@henu.edu.cn. We are grateful for many helpful comments and suggestions by Joshua Aizenman, Benjamin Born, Alexandra Fotiou, Matthias Klein and Thomas Krause, and participants of the 5th HenU / INFER Workshop on Applied Macroeconomics. We thank Julia Bobrzyk for her excellent research assistance.

1 Introduction

It is widely acknowledged, that the determined response of monetary and fiscal policy to the global financial crisis in 2007/2008 stopped the global economy from falling into an even deeper recession as it happened 80 years earlier during the Great Depression. Correspondingly, "Keynesian" policies have been experiencing quite a renaissance. Accordingly, the European Union has been highly criticized for imposing austerity on some of the highly indebted European countries such as Italy and Greece.[1] However, increasing spending in those countries is far from a clear-cut solution for growth problems even from a traditional Keynesian perspective, where the government is supposed to save in good times to increase spending in bad times. Both countries are already highly indebted and it is at least questionable whether their lack of growth is a cyclical problem at all, or points to more structural issues that hamper growth in the long run. Capital markets are already weary regarding the fiscal position of those countries (and many others). This increases the probability that getting deeper into the red generates substantial risk premia which in turn affect the economy and create crowding out. Thus, consolidating might be unavoidable.

In this paper, we investigate to which extent the fiscal position (of which debt levels are only one dimension) affects fiscal multipliers in OECD countries. Thus, we are able to address the question when a country should consolidate. Moreover, by using disaggregate data on fiscal policy shocks, we can document that consolidation through spending is preferable to consolidation through tax increases, and that announcements of future consolidation measures only work in tranquil times when the fiscal space of governments is far from being exhausted.

Recent years saw quite a few papers estimating state dependent multipliers. So far the literature has focused mostly on distinguishing the impact of fiscal policy during recessions and normal times, see for example Auerbach & Gorodnichenko (2012a), Auerbach &

[1] The European Commission has pushed Italy to meet its obligations under the Maastricht treaty. In the even more debated case of Greece, however, Greece no longer had access to the international capital markets due to de facto being in a state of default. The European Union introduced some measures to alleviate the lack of access to credit, but not to the degree that the Greek government preferred.

Gorodnichenko (2012b) and Canzoneri, Collard, Dellas & Diba (2016).[2] Although the expansionary policy in response to the great recession has pushed up debt levels across the globe and many countries are overindebted when applying pre-crisis standards, there has been little empirical research on the impact of the new fiscal fragility on the impact of fiscal policy. One of the few papers explicitly considering the role of debt is Favero & Giavazzi (2007). By including debt over GDP as exogenous variable in a VAR-X, and tracking it using the predictions for GDP and debt from their VAR they implicitly create a nonlinearity in government spending through its indirect effect transmitted through debt. Yet, their paper is otherwise still using a standard VAR framework. In other words, the nonlinearity is still restricted to the specific functional form of the debt accumulation equation.

Our paper contributes in two ways to the existing research. First, it fills the afore mentioned gap in the literature. Using a sample of 17 OECD countries from 1978 to 2009, we estimate the short and medium term impact of fiscal policy on GDP, dependent on the stage of the business cycle and fiscal vulnerability. As Auerbach & Gorodnichenko (2012a) we use local projections (Jordà 2005) rather than a VAR to produce impulse response functions (IRFs) based on the narratively identified spending shocks (or rather fiscal consolidation shocks) compiled by Devries, Guajardo, Leigh & Pescatori (2011) and augmented further by Alesina, Favero & Giavazzi (2015). Our specification takes into account that the effect of tax hikes might differ from spending cuts (Alesina & Ardagna 2010), both because taxes (unlike spending) are no demand component themselves and thus only have second order effects, and because they are oftentimes distortionary. Additionally, we account for the fact that surprise announcements of future consolidation might differ from implementing consolidation surprisingly (Ramey 2011, Mertens & Ravn 2011, Mertens & Ravn 2012). Indeed, we find that the type of consolidation and the fragility of sovereign finances matter. In general, consolidation through spending cuts has less contractionary effects than consolidation through increasing taxes. In particular, this is true for surprise

[2] Recent papers also distinguish between unconstrained monetary policy and the zero lower bound (Fernández-Villaverde, Gordon, Guerrón-Quintana & Rubio-Ramirez 2015, Miyamoto, Nguyen & Sergeyev 2018).

spending cuts in times of fragile sovereign finances: under such circumstances, GDP does only barely react, while the contractionary effects of other policy changes can be large.

Second, we add to the growing literature that discusses the adequate measurement of fiscal fragility (Aizenman & Jinjarak 2012, Ghosh, Kim, Mendoza, Ostry & Qureshi 2013, Kose, Kurlat, Ohnsorge & Sugawara 2017). Our paper includes both a battery of ad-hoc measures that have been used in the previous literature, and more theoretically founded measures. While our results are qualitatively robust, we demonstrate that theoretically founded measures for financial fragility are better suited than simple ad-hoc-measures and are also preferable to measures coming from auxiliary regressions that may suffer from estimation uncertainty.

2 Data

In this paper, we use local projections to identify state dependent effects of fiscal consolidation shocks, see Section 3. In particular, we are interested in the question how these effects vary with fiscal fragility. The empirical literature on fiscal policy went through some drastic developments over the past years.There have been heated debates on how to identify fiscal policy shocks (or which type of fiscal policy shock to focus on to guarantee exogeneity) and regarding the measurement of fiscal fragility (or more generally an unsound fiscal situation). In the following we discuss our measurement choices in detail in subsections 2.1 and 2.2. We briefly introduce our control variables in subsection 2.3.

Summary statistics for all variables can be found in table A.3 in the Appendix. Table A.2 reports the time-coverage by country, broken down for the different ways we measure fiscal space.

2.1 Fiscal policy shocks

Measuring fiscal shocks Traditionally fiscal policy shocks have been identified through various restrictions on the covariance matrix in structural VARs (see among others Blanchard & Perotti (2002), Perotti (2007), Favero & Giavazzi (2007), and Mountford & Uhlig

(2009) to name just a few examples that shaped the literature considerably). From its very beginning, the literature was plagued by the question whether such “shocks” are truly exogenous. Building on the seminal paper by Ramey & Shapiro (1998), particularly for the US a lot of papers utilized military spending as an instrument to identify shocks, since it is typically not dependent on the business cycle. Finally, Romer & Romer (2010) provided a dataset for narratively identified fiscal policy shocks for the US based on congressional records.

Based on this idea, Devries et al. (2011) developed a multi-country database on narratively identified fiscal consolidation shocks, differentiating between consolidation through tax and through spending changes. Alesina et al. (2015) augment this measure to capture entire multi-year fiscal plans, allowing to explicitly account for the difference between announcement and implementation of consolidation measures. The focus on consolidation shocks does not allow us to address differential effects of expansionary and contractionary shocks. Moreover, as with all shock measures, we do not know if our shocks constitute permanent or temporary changes in fiscal policy (beyond the planning horizon of announcements). The shock measures that we will construct based on this dataset are arguably exogenous to the business cycle, as discussed below. They are therefore extremely well suited to be included in local projectionsbecause the exogeneity allows us to regress output directly on our shock measures. Local projections are in turn our method of choice because they are one of the most flexible ways to incorporate the nonlinearities we are interested in.

Fiscal consolidation plans and their changes The database includes *unexpected* changes of taxation τ_t^u at time t, the *unexpected* changes in government spending g_t^u and the fiscal plans, i.e. changes of taxation $\tau_{t,h}^a$ and spending $g_{t,h}^a$ *announced* at time t up to horizon $h = t + 5$, including the current year $h = 0$ (most countries only make plans up to three years in the future). Future announcements are often still subject to change, i.e.

$$\tau^a_{t,h} = \tau^a_{t+1,h-1} + (\tau^a_{t,h} + \tau^a_{t+1,h-1}) \quad (1)$$

$$g^a_{t,h} = g^a_{t+1,h-1} + (g^a_{t,h} + g^a_{t+1,h-1}), \quad (2)$$

where the term in parentheses is the update of the plan for period $t+h$ announced between t and $t+1$. Note that there is no such update for $h = 0$. That is, all unannounced changes in spending or taxes in the current period are considered to be surprise changes.[3]

For our purpose we want to distinguish fiscal consolidation in two dimensions. First, we want to consider both tax and spending based consolidation separately. Second, we want to distinguish unexpected changes (i.e. contemporary shock to fiscal policy) from unexpected changes to plans (i.e. expectation shocks) that might play a different role for the economy. (Alesina et al. 2015) demonstrate that future announcements (i.e. plans for $h > 0$) are highly correlated to unexpected changes. This is of course intuitive, since it may be optimal to spread consolidation measures over a longer period, instead of implementing a much larger one-off change of fiscal policy. To get the unexpected component of fiscal plans, we therefore have to correct for contemporary unexpected changes.

We therefore define:

$$\tau^a_{t,1} = \mu_\tau \phi_1 \tau^u_t + \phi_2 g^u_t + \eta_t \quad (3)$$

$$g^a_{t,h} = \mu_g + \psi_1 \tau^u_t + \psi_2 g^u_t + \varepsilon_t, \quad (4)$$

where η and ε are considered as *expectation shocks.* Announcement changes for horizons larger than 1 are typically very small. Therefore, we only consider expectation shocks for the near future, i.e. the following year. Together with the two *unexpected* shocks τ^u_t and g^u_t, the *expectation shocks* η_t and ε_t form the four different shocks used in this paper.

[3] In the data provided by (Alesina et al. 2015), Canada seems to deviate from this rule with a range of quantitatively extremely small changes between $\tau^a_{t,1}$ and $\tau^a_{t+1,0}$ ($g^a_{t,1}$ and $g^a_{t+1,0}$). We just treat this as measurement error due to the size of changes.

Exogeneity Since Devries et al. (2011) proposed their measure, there has been some debate on the exogeneity of the fiscal plans and thus the potential to be used as "shock" in empirical models. Arguments against exogeneity are to some degree unsurprising due to the focus on consolidation: Usually, there has to be a pressing reason to consolidate, such as approaching a situation that is deemed unsustainable. Such a situation naturally introduces an element of predictability. However, empirical evidence showing that the narrative shocks are endogenous (or at least predictable) mostly seems to refer to Guajardo, Leigh & Pescatori (2014), who use the sum of all policies implemented at time t, $\tau_t^u + \tau_{t,0}^a + g_t^u + g_{t,0}^a$, as shock. Jordà & Taylor (2016) demonstrate that this measure can be forecasted. This of course is true by construction since implemented policies $g_{t,0}^a$ and $\tau_{t,0}^a$ have been announced in previous years, allowing agents to adapt. Moreover, Alesina et al. (2015) show that annoucements with respect to future periods ($g^a t, h$ and $\tau^a t, h$) are correlated to current unexpected spending and tax shocks (g_t^u and τ_t^u), introducing autocorrelation into the Guajardo et al. (2014) measure. Controlling for unexpected spending and tax shocks, we find that both our expectation shocks are essentially unpredictable from past business cycle and fiscal fragility indicators , using the set of variables described later. Unexpected spending and (to a much lower degree) unexpected taxes can partially be explained. That is, there is a significant impact of lagged debt, primary balance and their own past on τ_t^u and g_t^u, but the degree to which they can be explained is extremely low (around 20% for spending and around 10% for tax), which seems to be economically irrelevant.[4]

2.2 Measuring fiscal fragility

How important measurement is to properly understand fiscal fragility can most easily be seen by simply comparing two of the measures that have been dominating the literature over the past decades, namely debt (over GDP) and interest payments (also related to GDP). It is glaringly obvious that the difference between those goes far beyond differences

[4]This matches the finding of (Alesina et al. 2015) who argue that the seeming predictability of "unexpected" spending and tax in Jordà & Taylor (2016) is due to the fact that they focus on the existence of consolidation (i.e. they run a binary model) and ignore the magnitude.

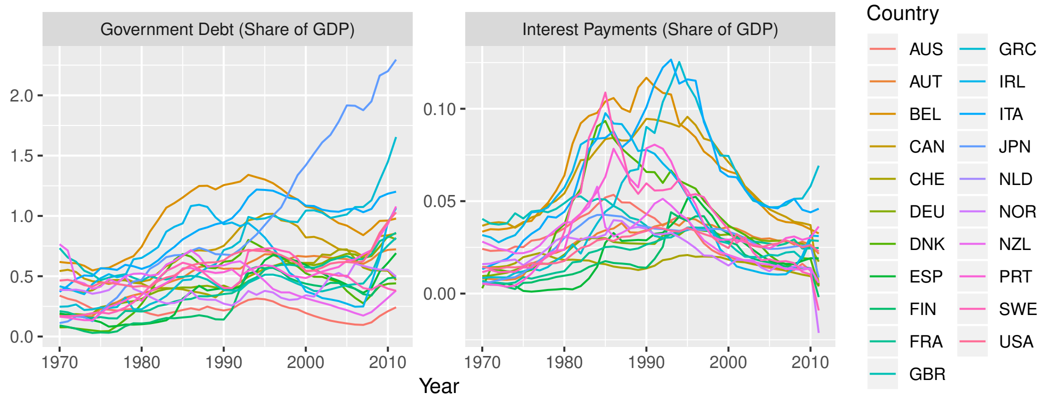

Figure 1: Different ad-hoc fragility measures

Note: Variables are measured as share of GDP. That is, a "1" stands for 100% of (yearly) GDP.

in precision. Rather, the development of interest payments and debt delivers starkly different pictures.

Debt (see the left plot of Figure 1) tells the story we are all familiar with. For decades, debt – and thus fiscal fragility – has been increasing with many countries facing particularly hard times since 2008, when debt skyrocketed due to the expansionary fiscal policies that were used to stop the crisis. Interest payments (the right plot of Figure 1) on the other hand have been going down on average since the early nineties. This has partly been driven by loose monetary policy and the general downward trend of interest rates during the Great Moderation, but it is at least equally strongly driven by the decline of interest rate spreads in the Euro Area in the preparation for the currency area and even more after its introduction. Since (policy) interest rates collapsed even further in response to the crisis, only few countries experienced increasing interest payments even then. Rather, interest payments have been declining for most countries, as more and more debt is being rolled over with the new debt being issued at lower rates.

A large part of the previous literature has focused on such simple measures of the fiscal situation. In particular the debt to GDP ratio enjoys continued popularity due to its straightforward computation (see for example the much debated paper by Reinhart & Rogoff 2010). However, it has long been observed that the same level of debt can be problematic for some countries while being easily sustainable for others. Originally, this has mostly been addressed by replacing the debt to GDP ratio by interest rate payments.

Interest payments have the great advantages of (a) combining the level of debt with a market based assessment of the riskiness of that debt, and (b) being a very direct measure of the burden that debt actually puts on a specific country.

In recent years, however, a literature has emerged that tries to go beyond those ad hoc measures, and looks at a range of different indicators under the keywords "fiscal space" or "fiscal capacity". Although being quite different in details, those concepts all aim at providing a theoretically founded estimate of the "wiggle room" a government still has for fiscal policy, or – in more formal terms – how close it is to its budget constraint.[5]

Contrary to fiscal shocks, where we employ the one measure that is most suitable for our empirical approach, we run different models with a large battery of alternative fragility indicators, allowing us to contribute to the literature on proper measurement of fiscal fragility in addition to our main objective (i.e. the identification of the impact of consolidation shocks).

We regress GDP per capita on an exogenous fiscal shock, which we interact with different measures of fiscal fragility, including (a) traditional measures of fiscal fragility and (b) different modern measures of fiscal space. We add the interaction of the shock variable and a business cycle indicator, and several additional control variables measuring business cycle dynamics.[6]

Table 1 summarizes the indicators we use.[7] We start with the afore mentioned ad-hoc measures of fiscal fragility: Debt/GDP, interest payments/GDP and the primary balance/GDP (see last column of the table). Additionally, in the spirit of going for broad measurement, we add rating information for foreign-currency denominated sovereign bonds from El-Shagi & von Schweinitz (2018). This indicator measures the market perception of fiscal fragility (Kose et al. 2017), but has a much larger data availability than CDS spreads.[8]

[5]For surveys over the recently developed measures of fiscal space see e.g. Cheng & Pitterle (2018) and Botev, Fournier & Mourougane (2016).

[6]Usually, control variables are not necessary for local projections, but increase estimation efficiency. However, while the shock should be orthogonal to the remaining data, interactions of the shock are not. To prevent an omitted variables bias and wrongly assigning the corresponding effects to fiscal fragility, we need the additional control variables.

[7]More details, including summary statistics, can be found in table A.3 in the Appendix.

[8]Data availability is also the reason why we do not use the afore mentioned database of Kose et al.

Table 1: Fiscal space measures

	Measure	Used in model
Simple measures	Debt / GDP	Simple measures
	Interest / GDP	Simple measures
	Primary balance / GDP	Simple measures
	Ratings	Simple measures & AJ
Intuitive fiscal space measures	Debt / long-run tax base	AJ
	Interest / long-run tax base	AJ
	Primary balance / long-run tax base	AJ
Model based fiscal space measures	Fiscal space	G&al

Note: AJ refers to Aizenman & Jinjarak (2012); G&al refers to Ghosh et al. (2013).

We then move to theoretically more founded measures, that try to actually approximate fiscal space. Following Aizenman, Jinjarak, Nguyen & Park (2019) (AJ) we use the ratio of debt to the long-run tax base. This ratio indicates how long it would take to pay off government debt, if the entire tax revenue would be spent on debt service alone. This is of course nothing a government could (or should) actually do. However, it emphasizes the fact that the amount a government can borrow crucially depends on the amount of taxes it can levy. By focusing on the long-run tax base – which is computed as a backward-looking three year moving average of tax revenue – this indicators avoids being subject to fluctuations that are merely driven by the business cycle. Based on this line of thinking, we also include interest payments and primary balances over the long-run tax base as improved counterpart of the alternative simple measures introduced before. For reasons of better comparison, we add ratings to the AJ-model as well.

Recent years have also seen a range of publications that aim to estimate the actual fiscal space in the sense of a difference between an upper feasible boundary for debt $\bar{d}$ and current debt d. This approach is appealing insofar as it allows to emphasize future economic developments, rather than being backward-looking. The key issue with

(2017), which contains 22 different variables associated with fiscal fragility. Even if we would restrict ourselves to the eight indicators with the highest overlap to our shock data, we would lose 40% of observations. Among those eight indicators, only domestic credit to private households would be an addition to the variables listed in table 1.

those approaches is that $\bar{d}$ cannot directly be measured and thus has to be estimated. This introduces – often considerable – estimation uncertainty and/or reliance on strong assumptions. In our third model, we replicate the method proposed by Ghosh et al. (2013) (G&al) for our sample of OECD countries. Their estimation is based on the rule of motion of debt:

$$debt_{t+1} = debt_t + (i_t - g_t)debt_t + pb(debt_t, X_t), \tag{5}$$

where *debt* is the debt/GDP ratio, i is the interest rate on government debt, g is the growth rate of GDP and *pb* is the primary balance. Ghosh et al. (2013) argue that the primary balance is typically a nonlinear function of debt (and other controls X), that can well be approximated by a cubic polynomial. The economic intuition is that the debt elasticity of the primary balance is decreasing with higher debt levels, as governments become less willing and capable to increase the primary balance enough to maintain a stable debt level. Under such a specification, the relation of primary balances and debt yields a law of motion for debt with (usually) three fix points. An unstable low debt equilibrium, a stable medium debt level equilibrium, and an unstable high debt equilibrium that reflects the debt ceiling $\bar{d}$. Beyond $\bar{d}$, the primary balance is not able to compensate the interest rate payments (adjusted for GDP growth), independent of other determinants of debt sustainability, as for example the interest-growth rate differential (Blanchard 2019). The debt limit $\bar{(}d)$ is accordingly given by the largest value (fixed point) fulfilling

$$\mu(X_t) + f(\bar{d}) = (i_t - g_t)\bar{d}, \tag{6}$$

where $f(\bar{d})$ is the cubic polynomial of debt in equation (5), and μ depends on country-fixed effects and the additional control variables X_t.

We use the most simple version of the model, where the primary balance is a function of lagged debt (up to a cubic term), the GDP gap and a government expenditure gap. More sophisticated versions of the model are well possible. In particular, the interest rate can also be modeled as a function of debt to illustrate that the interest rate typically increases after some debt threshold is exceeded. This produces lower debt ceilings. While those might be more realistic, the additional uncertainty carried into the model is considerable. We find that even in the simple model, the debt ceilings vary widely in our sample, to an extent where economic plausibility is questionable. Since debt ceilings with "constant" interest rates and debt dependent interest rates are highly related by construction, we stick to the simple model and refrain from adding additional uncertainty into a nonlinear model with few degrees of freedom.

Still, it turns out that the construction of fiscal space is extremely sensitive to seemingly minor changes in the underlying assumptions. In particular, the calculation of an upper debt limit $\bar{d}$ in equation (6) is sensitive to the interest-growth rate differential $i_t - g_t$, and the way control variables affect μ. In particular, variation of interest-growth rate differentials and μ over time can lead to cases where equation (6) has only one real-numbered fixed point at negative debt limits, instead of the usual three.

Ghosh et al. (2013) argue that debt limits should depend on long-run developments rather than short-run fluctuations. They chose a country-specific 10-year moving average for the interest growth differential, and use the current values of control variables for the one year (2007) they report. Indeed, for 2007 it makes little difference, because equation (6) has three real-valued solutions for nearly all countries. The reason for this is the particularly positive GDP gap that results in an extreme value of μ. This is different in our case where we are interested in the full history of fiscal space. We generally find economically the most plausible results when we apply the same argument (i.e. looking at the long run) to control variables in μ.

Our baseline measure of fiscal space is shown in Figure 2. For this measure, we introduce as much stability as possible by using country-specific averages of both the interest-growth rate differential and the control variables entering μ in equation (6). Thus, the measure varies with (lagged) debt levels, with the degree of variation being determined by the primary balance reaction function.

Figure 3 displays the baseline measure in the first subplot, and two alternatives in the two additional subplots. For the fiscal space measure in the third subplot, we follow

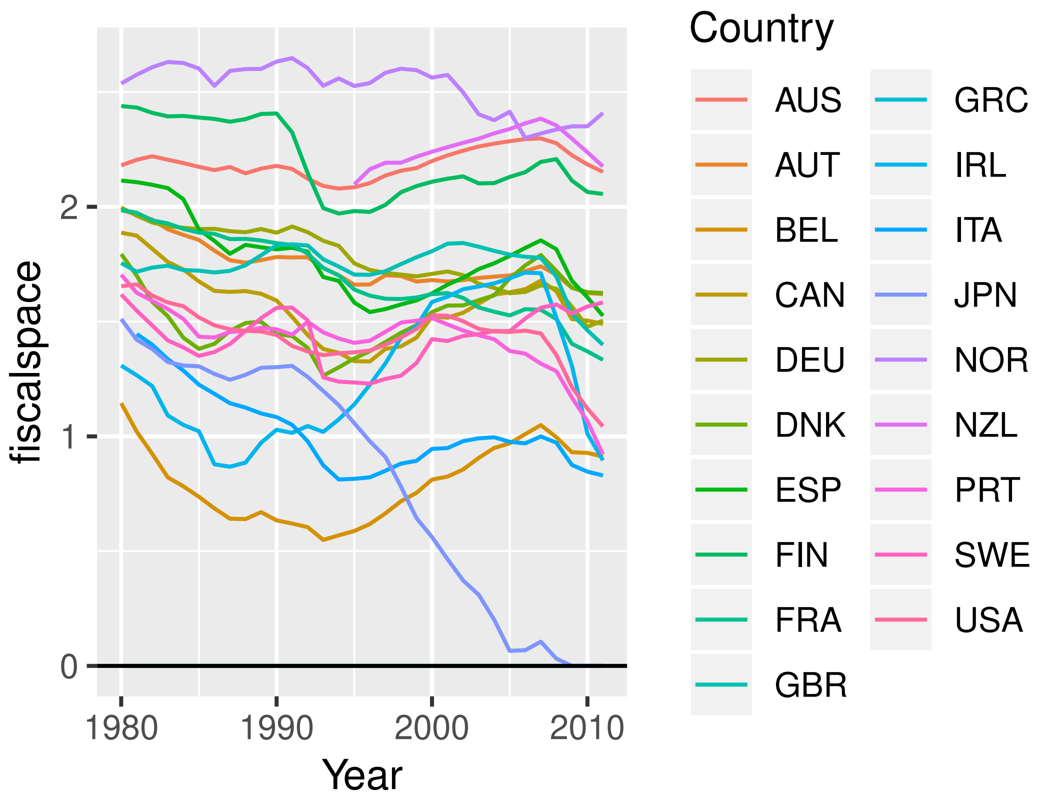

Figure 2: Fiscal space, G&al

Note: Fiscal space is measured as a share of GDP (i.e., 1 stands for 100% of GDP).

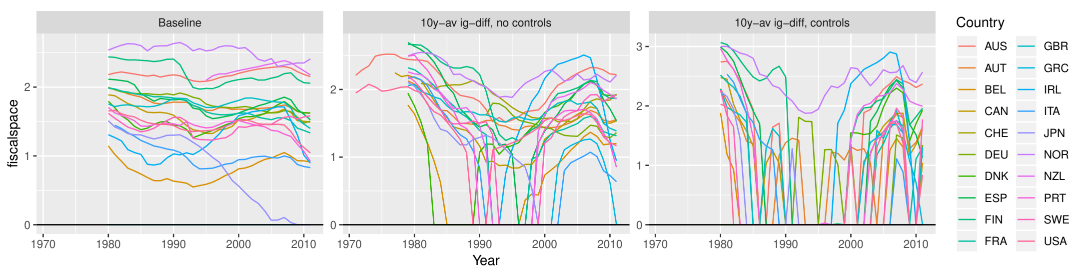

Figure 3: Fiscal space, G&al, alternative specifications

Note: Alternative specifications of fiscal space, measured as a share of GDP (i.e., 1 stands for 100% of GDP). The left subplot shows the baseline also presented in Figure 2 for comparison. The mid subplot presents fiscal space based on 10-year averages of the interest-growth rate differential, but excluding all additional controls, used in a robustness check. The right subplot shows fiscal space based on 10-year averages of the interest-growth rate differential and fully time-varying additional controls. This measure is closely related to the description in (Ghosh et al. 2013).

Ghosh et al. (2013). That is, we use country-specific 10-year rolling window means for the interest-growth rate differential, and original values without averaging for μ. We see that fiscal space in 2007 is mostly positive, but fluctuates wildly before and after. In particular, there are sudden jumps from values of above 100% of GDP in one year to 0 (negative values without truncation) in the next. These jumps are the result of having only one unstable fixed point. Similarly disturbing we find that the median fiscal space for this measure is zero, see Table A.3 in the Appendix. That is, the OECD countries in our sample have exhausted their fiscal space (according to this measure) in more than 50% of the cases. Certainly, this is not realistic, since Greece has been in default as the only country in our sample.

The variation presented in the mid subplot of figure 3 is subject to the first criticism (abrupt jumps), but not the second. For this measure, we use country-specific 10-year rolling window means for the interest-growth rate differential, but remove both the GDP gap and the government expenditure gap as control variables from both the estimation of the primary balance reaction function $pb(debt_t, X_t)$ and from μ. Dropping business cycle variables from the primary balance reaction function reduces estimation efficiency, but increases stability, thus avoiding many of the abrupt switches in fiscal space.[9] Only in 14% of observations, fiscal space is exhausted according to this measure. Taken together, this fiscal space measure could also be plausible. Therefore, we present results in a robustness check.

2.3 Macroeconomic controls

In addition to the above variables, we control for standard variables in a fiscal VAR (Blanchard & Perotti 2002). These are real GDP per capita, real consumption per capita, real investment per capita, government spending and revenue as a share of GDP, short run interest rates and CPI inflation. For all variables, we include the first two lags. Moreover, we add the first two lags of all four shock variables to all estimations. Results

[9] We tested many other variations. Abrupt jumps become much more frequent with less stable interest-growth rate differentials and μ. Moreover, the baseline and the variant presented in the mid subplot are the two only variations with a positive median fiscal space.

are robust to leaving the "shock-controls" out.

3 Model and method

3.1 Local projections

Relying on the exogenous Alesina et al. (2015) shocks allows us to estimate the impact of shocks over various horizons directly using local projections (Jordà 2005), rather than having to estimate a VAR to simultaneously estimate the dynamics of the variables of interest and the shocks themselves.

Rather than producing iterative forecasts, where the $h+1$-step ahead forecast is based on the h-step ahead forecast, we estimate a set of equations

$$y_{t+h} = F(d_t, Y_t, Z_t), \tag{7}$$

where d is a shock, y_t is the variable of interest at time t, Y_t is the history of the same variable at time t (i.e. y_t, y_{t-1}, etc, and Z_t a vector of predetermined covariates. The impulse response function is then defined as

$$irf_h = \hat{F}(\tilde{d}, \tilde{Y}, \tilde{Z}) - \hat{F}(0, \tilde{Y}, \tilde{Z}), \tag{8}$$

where $\tilde{d}$ is a hypothetical shock, and $\tilde{Y}$ and $\tilde{Z}$ are the "scenario" that the IRF is conditioned on. While F can theoretically be of any functional form and $\hat{F}$ can be estimated in an arbitrary way, one of the main advantages of local projections is that we can easily model the degree of nonlinearities through polynomials and interactions of the included variables and then proceed estimating the resulting linear equations using OLS.

3.2 Model specification

For our paper, we focus on interactions of the shock variable with indicators for the state of the business cycle and fiscal space. We estimate a range of models, all taking the general shape:

$$y_{i,t+h} = \theta_0 f_{i,t} + \theta_1 f_{i,t} gap_{i,t-1} + \Theta_2 f_{i,t} Frag_{i,t-1} + \gamma_0 y_{i,t-1} + \Gamma_1 Z_{i,t-1} + \Gamma_2 Z_{i,t-2} + u_i + v_t + \varepsilon_{i,t}, \quad (9)$$

where y is GDP, f is one of the fiscal consolidation shocks described in detail in Section 2, gap is the GDP gap, $Frag$ contains all measures of fiscal space from one of our three alternative sources, and Z contains all additional control variables (including $Frag$ to account for their individual effect, and all four lagged consolidation shocks). We include both country- and time-fixed effects (u_i and v_t). The horizon h ranges from 0 to 5, i.e. our impulse responses go from the contemporaneous effect to a 5-year horizon. Since we include the contemporaneous effect, all indicators except the exogenous shock are lagged by one period to avoid issues of endogeneity.

All our data are restricted to be common across h. This ensures that impulse response functions plotted for one observation are based on the same set of explanatory variables and observations for all displayed horizons. The GDP data used extends beyond the available fiscal shock time series, thereby allowing us to use the entire available information regarding fiscal policy for all horizons.

3.3 Scenarios

The key advantage of this approach is that we can easily compute impulse responses for different initial conditions. Our main interest is in differentiating between situations where the fiscal situation is fragile and a sound fiscal situation. However, since the past literature has focused on regime changes over the business cycle – which might be correlated with fiscal fragility – we consider both the "stable" and the "fragile" situation in "normal times" and during a recession, which we identify as periods where the GDP gap is at its 20^{th} percentile.

In the "fragile" scenario, we condition on extreme percentiles of all fragility indicators jointly. Just as with the state of the business cycle, we choose the 80^{th} percentile for indicators where high values would be considered fragile (like sovereign debt), and the

20^{th} percentile for indicators where fragility should rather exist at low or negative values (like the primary balance).

Table 2: Scenario summary

Scenario	Fragility	Cycle
Baseline	Stable	Normal
Fragile	Fragile	Normal
Recession	Stable	Recession
Fragile & Recession	Fragile	Recession

Note: *Stable* refers to the median of the fragility measure; *Fragile* to the 80^{th} (20^{th}) percentile of all included fragility indicators; *Normal* (*Recession*) refers to the median (20^{th} percentile) of the business cycle indicator.
The two scenarios *Recession* and *Fragile & Recession* are used in a robustness check.

4 Results

In this section, we will first discuss the different measures of fiscal fragility from a perspective of model fit. The reason for such a discussion is to put the different fragility measures into perspective. In a second and third subsection, we present the baseline reactions to surprise and announcement consolidation shocks. Our main results are: First that spending consolidation is less contractionary than consolidation through tax increases; and second that consolidation through surprise shocks is highly preferable in times of fragile government finances. We confirm these findings in a series of robustness checks.

4.1 Explanatory power of fiscal space measures for GDP

Before we discuss the effects of consolidation shocks on GDP conditional on different measures of fiscal space, we discuss the explanatory power of different measures of fragility and its implications for the suitability of those measures in empirical models. Although we also use alternative models in the robustness section of the paper, the following discussion is based on the fit within our baseline specification given in Equation (9). Note that Equation (9) is reestimated for every $h \in \{0, \dots, 5\}$.

Table 3 reports the number of observations and degrees of freedom for every of these estimations. The fiscal space measure of Ghosh et al. (2013) has the largest data availability with nearly 400 observations, closely followed by the simple measures (debt, primary balance and interest payments expressed as share over GDP) and the tax-based measures of Aizenman & Jinjarak (2012).[10]

The table also reports the adjusted R^2, aggregated over all estimated forecast horizons. The explanatory power of our estimated models is indeed fairly high, ranging from roughly 60% to 75%. If we break down explanatory power by horizon h, we find increasing adjusted R^2 for longer horizons. That is, our yearly data seem in general to be better suited to estimate steady-state developments than short-run fluctuations.

In a comparison across fiscal fragility measures (reported in rows), we see roughly an inverse relationship between data availability and adjusted R^2. This is not unusual, as it is often easier to fit a model to smaller datasets. Indeed, when we restrict the data to a common sample, we see that only estimations using fiscal space by G&al fall off against the other two variants, see Table A.4 in the Appendix. A direct comparison using the largest amount of data is only possible for the GDP-based and tax-based measures that work on nearly the same observations. Here, we see that the measures based on the long-run tax base are consistently (slightly) better than the simple ad-hoc measures. This is indeed nice to see because the former have a stronger theoretical foundation than the latter. The fiscal space measure of G&al is, as described above, quite sensitive to modeling assumptions. For this reason, we would again put the tax-based measures first.

For the same measure of fiscal space, the adjusted R^2 changes only very little if we replace one consolidation shock by another, as shown by different columns in the table. That is, different consolidation shocks (and their interaction with fiscal space) are nearly equally important for the development of GDP.[11]

All our measures of fiscal fragility except G&al are based on four different indicators. In addition, the consolidation shock is always interacted with the GDP gap. This

[10] The difference comes from interest payments, which are not included in the computation of fiscal space.

[11] Many of the impulse-response functions shown in the following subsections are significant, indicating that the explanatory power of consolidation shocks is non-zero.

Table 3: Adjusted R^2 for baseline models

	Spending surp.	Tax surp.	Spending ann.	Tax ann.	Nobs	df
Simple measures	0.670	0.667	0.670	0.668	353	274
AJ	0.681	0.675	0.681	0.682	350	271
G&al	0.641	0.646	0.648	0.641	392	322

Note: AJ refers to Aizenman & Jinjarak (2012); G&al refers to Ghosh et al. (2013)

raises the question if indeed all of these indicators are important predictors of GDP in our estimations. We performed Wald tests where fiscal space indicators (and the GDP gap) where excluded from the set of control and interaction variables one at a time. Figure 4 reports the p-values of these tests with different variables in subplots, different consolidation shocks on the x-axis, and one dot per forecast horizon $h \in \{0. \dots, 5\}$. Consistent with previous results on the importance of the stance of the business cycle for fiscal multipliers, we find the GDP gap to be extremely important. In addition, debt and the primary balance (as shares of average tax revenues) should be included in almost all regressions. Interest payments and ratings seem not to add too much additional information. This squares nicely with the theoretical model of Ghosh et al. (2013), which puts a comparably larger focus on public debt levels and the reaction of primary balances to debt, and less of a focus on interest rates and interest payments. This also echoes the previous literature finding that fiscal multipliers may depend on the level of debt (Reinhart & Rogoff 2010, Eberhardt & Presbitero 2015).

If we measure fiscal space with simple GDP-based measures, we find an even stronger focus on debt levels.[12] In this case, only debt and the GDP gap seems to be important.

4.2 The response of GDP to unexpected consolidation

In this subsection, we present the effects of unexpected consolidation. comparing the GDP reaction in normal and fragile times. The results for both spending and tax consolidation shocks are summarized in Figure 5.

[12]The corresponding plots for simple measures can be found in figure A.1 in the Appendix.

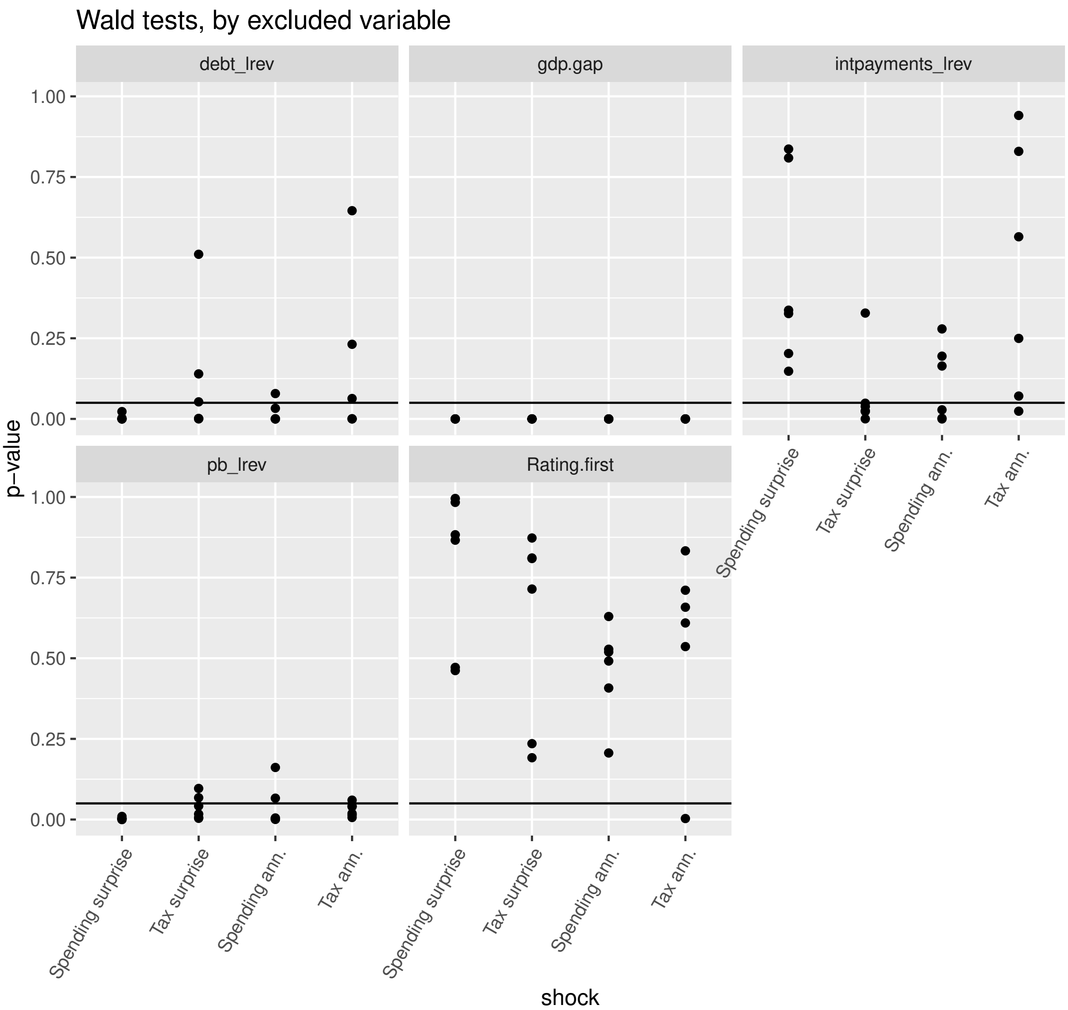

Figure 4: Wald tests for different variables, tax-based measures

Note: Wald tests refer to the null hypothesis of excluding the respective variable from interaction and control variables in the estimations using tax-based fiscal space measures by Aizenman & Jinjarak (2012). Dots show the p-value of Wald tests for estimations at different forecast horizons $h \in \{0. \dots, 5\}$.

Spending The results regarding unexpected spending shocks are mostly robust across different measures of fiscal fragility. For the fiscal space measure of G&al, multipliers are somewhat smaller, but not by much. Generally, we find a clearly contractionary effect in normal times. Spending multipliers are around 1. In fragile times, there is fairly strong evidence that spending consolidations are barely contractionary.Indeed,for our preferred measure AJ, the point estimate during fragile times is extremely close to zero over the entire IRF and insignificant in all periods (for all other measure we find a significantly negative result in at least two periods).

At first glance this seems to contradict the conventional wisdom that consolidating too late is disadvantageous. However, it has to be kept in mind that we look at conditional impulse responses. That is, the IRF at fragile times shows the difference between fragile times with and without consolidation, not the difference between consolidation at fragile times to "normal times". Put differently, our results do not speak to growth effects of fiscal fragility itself. If high debt levels are detrimental as found by Reinhart & Rogoff (2010), it can still be preferable to not allow debt to escalate.

When looking at our findings as evidence of more "Ricardian" behavior in fragile times, they are perfectly intuitive. When the government is running out of fiscal space, it is much more likely that it compensates for it's policy within the planning horizon of a typical household. Indeed, Hogan (2004) finds earlier evidence that consolidation may be even expansionary for consumption under fiscal fragility (although not for GDP as consumption increases do not fully offset spending cuts).

Taxes Unexpected tax based consolidation has generally similar but somewhat stronger effects. Whereas we found mostly negative but insignificant results for surprise spending consolidation in fragile times, the effects are clearly significant when looking at tax based consolidation, now reaching multipliers around 1. Consolidation in normal times has multipliers of roughly 2 over the entire 5 year horizon we consider. This points to an additional detrimental effect of taxation on future economic growth. That is, in addition to the negative multiplier effects through the income reduction, there might be distorting effects of taxes.

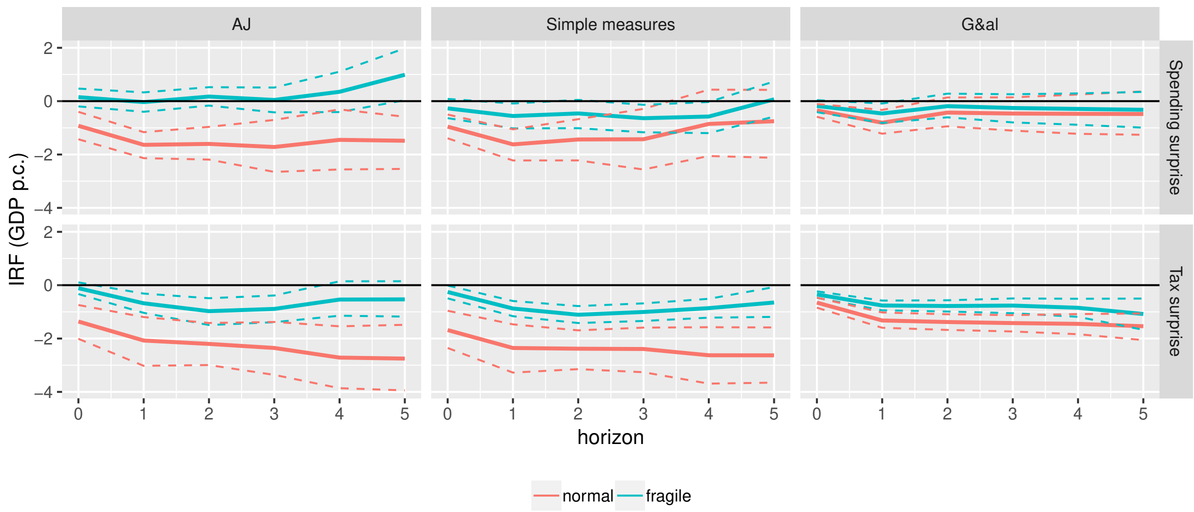

Figure 5: Response to surprise consolidation in baseline models

Note: The plots show impulse response functions for surprise (spending and tax) shocks in models with different fragility measures. Conditioning scenarios are described in Table 2.

4.3 The response of GDP to announcement shocks

Spending Announcements seem to play quite a different role. However, as described above, we construct announcement shocks as residuals from a regression of announcement changes on surprise shocks. That is, we remove the part of announcement changes that is correlated with surprise shocks. This implies that the total effect of announcement changes is the (weighted) sum of the impulse response functions shown in the previous subsection and the ones displayed and discussed in the following.

For basic measures, the AJ measures and in particular for fiscal space the effect of announcement shocks is stronger than the effect of actual surprises. For an announcement shock of 1% of GDP, GDP drops by about 2%. One reason might be that economic agents adapt their behavior in advance of the effective spending cut. On the other hand, the rewards (in terms of lower risk premia and interest payments) will only be delayed for announcements. The fiscal space of G&al is again an exception: there is basically no difference between normal and fragile times.

Taxes Regarding taxation, the difference between effects of surprise changes and announcements is less pronounced. Over a medium horizon, we again find that consolidation in fragile times has (slightly) less of an effect. However, this is typically not true on im-

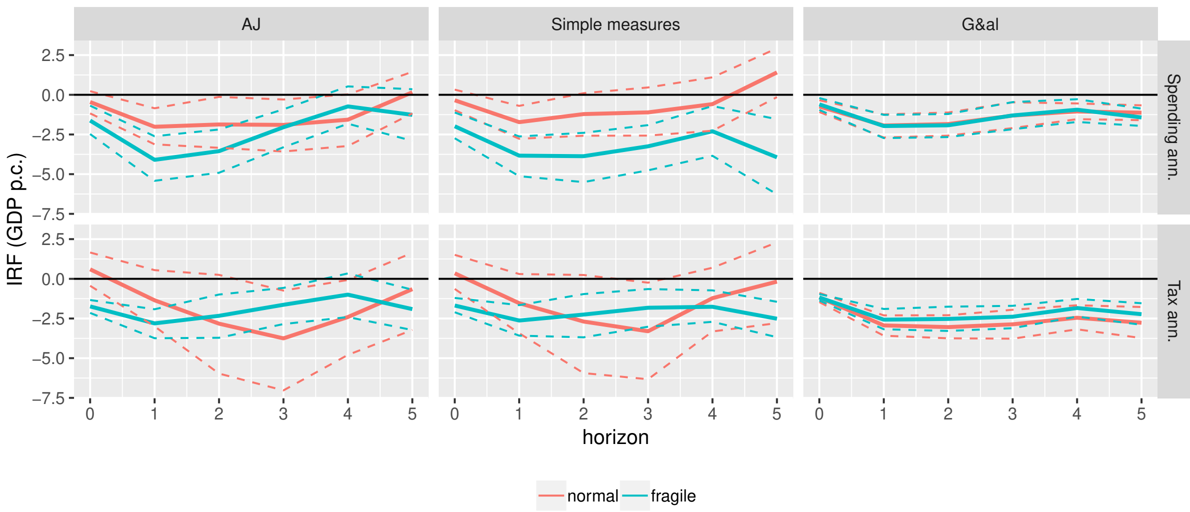

Figure 6: Response to announcement shocks in baseline models

Note: The plots show impulse response functions for surprise (spending and tax) shocks in models with different fragility measures. Conditioning scenarios are described in Table 2.

pact.

4.4 Robustness checks

The main findings of the previous section were that (a) consolidation is less contractionary in fragile times when it is performed through surprise changes in fiscal policy, (b) that the reverse is most likely true for announced changes in fiscal policy, and (c) that multipliers are in general higher for tax-based consolidation. In this section, we provide three robustness checks for these findings. First, we are going to check if our results also hold during recessions. This is relevant because multipliers have been found to be larger during recessions (Auerbach & Gorodnichenko 2012b, Auerbach & Gorodnichenko 2012a). Moreover, periods of severe fiscal fragility (i.e. sovereign debt crises) are both associated with a pressing need to consolidate and recessions. In our second robustness check, we extend the estimations with tax-based measures (AJ) and simple GDP-based measures by adding quadratic terms and interactions for measures of fiscal fragility. In a way, this allows us to mimic more closely the idea that the relation between fiscal fragility, fiscal policy and growth may be nonlinear (Ghosh et al. 2013, Reinhart & Rogoff 2010). In our third robustness check we provide results obtained from the alternative theoretical fiscal fragility measure of G&al discussed in section 2.2 above.

Multipliers during recessions Contrary to (Auerbach & Gorodnichenko 2012b, Auerbach & Gorodnichenko 2012a), we find that there is only a minor difference between a normal state of the business cycle and a recession. The main margin of variation between multipliers is with respect to fiscal fragility measures. Results are very similar to the baseline, with only slightly higher multipliers, see Figures A.6 for surprise shocks and A.7 for announcement shocks in the Appendix. One reason for this may be that the business cycle indicator is indeed correlated with our measures of fiscal fragility. Another reason could be that fiscal policy shocks with an eye on consolidation are somewhat different to more general fiscal policy shocks, which may depend more strongly on business cycle conditions (Alesina et al. 2015).

Multipliers with second-order interactions In this robustness check, we investigate potential nonlinear effects. However, we do not add all second-order interactions. The reason is that nonlinear functions – in order to generate a better in-sample fit – can return extreme predictions for unlikely scenarios. Our fragility scenario assumes that all measures of fragility are simultaneously at their 20^{th} percentile, which is quite rare in the data.[13] Instead, we only add interactions for those variables where the Wald tests presented in subsection 4.1 clearly reject that this variable can be disregarded. More precisely, we add $debt^2$, pb^2 and $debt * pb$ to the set of interaction variables in the AJ-model. For the simple measures, only sovereign debt is found to be very important. Thus, we only add $debt^2$ as an additional interaction variable.

Results for this robustness check are reported in Figures A.4 for surprise shocks and A.5 for announcement shock in the Appendix. We see very similar results as in the baseline, albeit with somewhat broader confidence bands. Especially for tax surprises the difference between the normal and fragile scenario is not as statistically significant.

[13]For example, debt levels have increased dramatically over the financial and subsequent European sovereign debt crisis, while interest payments have generally decreased as central bank interest rates have been pushed downwards.

Alternative fiscal space measure (G&al) Section 2.2 described that the fiscal space measure of G&al is sensitive to several assumptions regarding the long-run stability of the interest-growth rate differential and a constant shifter of the primary balance reaction function. Our alternative fiscal space measure uses country-specific 10-year rolling window means of the interest-growth rate differential, and disregard all potential additional control variables in the primary-balance reaction function. These changes introduce some additional time-variation in the fiscal space measure, but not too much. In particular, we avoid the unrealistic case that more than half of observations are classified as periods where fiscal space is exhausted (which is the case for all further alternative measures).

Results are again reported in the Appendix, in Figures A.6 for surprise shocks and A.7 for announcement shock. In the baseline, we found that the fiscal space measure of G&al showed particularly small differences between the two scenarios. For the alternative measure, the difference between normal and fragile times become more extreme. This lends some evidence to the interpretation that the larger differences found for the tax-based and GDP-based measures in the baseline are probably closer to the truth.

5 Conclusion

Our finding that consolidation in normal times is – at least in the short and medium horizon we consider – contractionary is hardly surprising. However, the result that consolidation in fragile times is barely so, has massive political implications. The frequently voiced concern, that countries that are already in a problematic situation cannot be expected to consolidate to avoid total collapse does not seem to be correct when looking at the empiricial evidence. We want to emphasize again, that this does not necessarily mean that it is the better choice for a country to consolidate, once it runs out of fiscal space. The possible detrimental effects of fragility itself – that would be necessary for that comparison – are not the subject of this paper. Our results do, however, show that there is no reason for further delays once the situation gets dire.

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Appendix

Table A.1: Data coverage, shock variables

Country	Start	End
Australia	1979	2007
Austria	1979	2007
Belgium	1979	2007
Canada	1979	2007
Germany	1979	2007
Denmark	1979	2007
Spain	1979	2007
Finland	1979	2007
France	1979	2007
Great Britain	1979	2007
Ireland	1979	2007
Italy	1979	2007
Japan	1979	2007
Netherlands	1979	2007
Portugal	1979	2007
Sweden	1979	2007
USA	1979	2007

Table A.2: Data coverage, by fiscal space measure

Fiscal space measure	simple measures		AJ		G&al	
Country	start	end	start	end	start	end
Australia	1982	2007	1982	2007	1982	2007
Austria	1982	2007	1982	2007	1982	2007
Belgium	1991	2007	1991	2007	1982	2007
Canada	1982	2007	1982	2007	1982	2007
Germany	1993	2007	1993	2007	1993	2007
Denmark	1988	2007	1988	2007	1982	2007
Spain	1991	2007	1991	2007	1982	2007
Finland	1982	2007	1982	2007	1982	2007
France	1982	2007	1982	2007	1982	2007
Great Britain	1982	2007	1982	2007	1982	2007
Ireland	1992	2007	1992	2007	1992	2007
Italy	1989	2007	1989	2007	1983	2007
Japan	1984	2007	1984	2007	1982	2007
Portugal	1989	2007	1989	2007	1982	2007
Sweden	1984	2007	1984	2007	1984	2007
USA	1982	2007	1982	2007	1982	2007

Note on abbreviations: AJ: Aizenman & Jinjarak (2012); G&al: Ghosh et al. (2013)

Table A.3: Summary statistics and data sources

	min	q25	median	q75	max	mean	sd	#NA	#obs	Source
Dependent variable										
Real GDP per capita, log LCU	9.11	9.97	10.25	10.67	15.20	10.71	1.36	0	493	WDI
Consolidation shocks (Guajardo et al. 2014)										
Spending surprise	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0	493	Alesina et al. (2015)
Tax surprise	-0.01	0.00	0.00	0.00	0.03	0.00	0.00	0	493	
Spending announcement	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0	493	
Tax announcement	-0.02	0.00	0.00	0.00	0.01	0.00	0.00	0	493	
Fiscal space (simple measures)										
Interest payments, % GDP	0.22%	2.72%	3.51%	5.59%	12.66%	4.39%	2.51%	29	464	HPF
General government gross debt, % GDP	9.63%	40.91%	56.56%	70.61%	191.64%	60.24%	30.57%	29	464	HPF
Primary balance, % GDP	-8.15%	-0.91%	0.92%	3.54%	11.62%	1.17%	3.29%	29	464	HPF
Foreign currency long-term sovereign debt ratings	20.00	22.54	24.00	24.00	24.00	23.26	1.09	67	426	El-Shagi & von Schweinitz (2018)
Fiscal space (Aizenman & Jinjarak 2012)										
Interest payments, % average tax revenues	1.00%	7.74%	11.31%	16.09%	32.51%	12.71%	6.87%	46	447	Calculations based on simple measures and tax base from Aizenman et al. (2019)
General government gross debt, % average tax revenues	30.65%	113.06%	155.05%	233.32%	755.19%	177.64%	101.03%	46	447	
Primary balance, % average tax revenues	-23.38%	-2.54%	2.72%	9.73%	27.89%	2.98%	9.19%	46	447	
Fiscal space (Ghosh et al. 2013)[(a)]										
Fiscal space (baseline)	0.00%	129.99%	158.45%	185.66%	264.77%	151.89%	60.58%	81	592	own calculations
Fiscal space (alternative 1)	0.00%	119.70%	157.39%	195.81%	269.45%	145.25%	71.74%	36	637	
Fiscal space (alternative 2)	0.00%	0.00%	0.00%	185.14%	306.71%	90.70%	102.56%	117	556	
Other interaction variables										
GDP gap (% potential GDP)	-7.00%	-1.54%	-0.27%	1.27%	11.03%	-0.02%	2.44%	18	475	WEO
Additional controls										
Real consumption per capita, log LCU	8.69	9.40	9.65	10.12	14.62	10.12	1.32	0	493	WDI
Real investment per capita, log LCU	7.62	8.48	8.78	9.23	13.98	9.25	1.40	0	493	WDI
Government spending, % GDP	14.33%	37.86%	45.97%	51.96%	71.72%	45.04%	8.72%	29	464	HPF
Government revenue, % GDP	12.82%	34.91%	42.03%	48.55%	60.55%	41.81%	8.76%	29	464	HPF
Short-run interest rates	0.05%	3.80%	6.11%	10.86%	24.90%	7.55%	4.70%	27	466	OECD
Inflation, CPI	-0.93%	1.88%	2.79%	5.26%	24.99%	4.22%	3.89%	0	493	WDI
Variables for the calculation of fiscal space (Ghosh et al. 2013)[(b)]										
Primary balance, % GDP	-28.17%	-1.12%	1.04%	3.94%	20.57%	1.31%	4.46%	0	556	WDI
General government gross debt, % GDP	9.63%	39.82%	56.95%	73.35%	229.61%	62.24%	33.58%	0	556	WDI
Real GDP growth	-9.58%	1.32%	2.55%	3.73%	10.09%	2.32%	2.34%	0	556	WDI
Inflation, GDP deflator	-5.35%	1.55%	2.72%	4.82%	22.06%	3.65%	3.62%	0	556	WDI
Long-run interest rates	0.99%	4.52%	6.32%	10.20%	29.74%	7.71%	4.36%	0	556	OECD
GDP gap (% potential GDP)	-11.33%	-1.63%	-0.29%	1.24%	6.86%	-0.20%	2.27%	0	556	WDI
Government spending gap	-2.24%	-0.20%	-0.01%	0.18%	3.68%	0.00%	0.43%	0	556	own calculations (HP filter)

Note on source abbreviations: WDI: world development indicators (World Bank); WEO: world economic outlook (IMF); OECD: OECD economic outlook; HPF: Historical Public Finance Dataset (Mauro, Romeu, Binder & Zaman 2015).

[(a)] The calculation of baseline fiscal space and the two alternatives is described in Section 2.2.

[(b)] The difference in summary statistics to the simple measures arises because the latter has been restricted to the availability of consolidation shocks.

Table A.4: Adjusted R^2 for baseline models, common sample

	Spending surp.	Tax surp.	Spending ann.	Tax ann.	Nobs	df
Simple measures	0.669	0.665	0.669	0.667	350	271
AJ	0.681	0.675	0.681	0.682	350	271
G&al	0.621	0.625	0.626	0.624	350	280

Note: AJ refers to Aizenman & Jinjarak (2012); G&al refers to Ghosh et al. (2013).

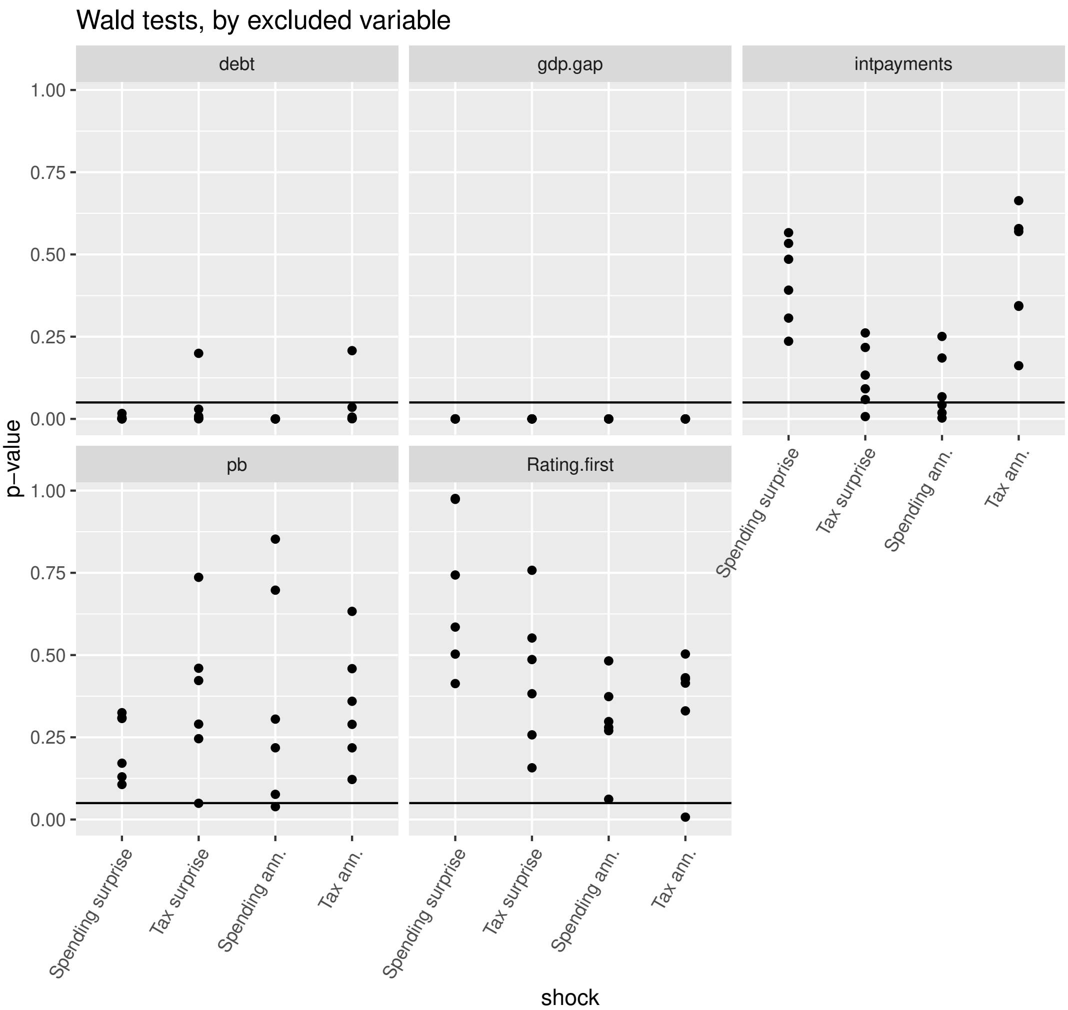

Figure A.1: Wald tests for different variables, simple measures

Note: Wald tests refer to the null hypothesis of excluding the respective variable from interaction and control variables in the estimations using simple fiscal space measures. Dots show the p-value of Wald tests for estimations at different forecast horizons $h \in \{0 \ldots, 5\}$.

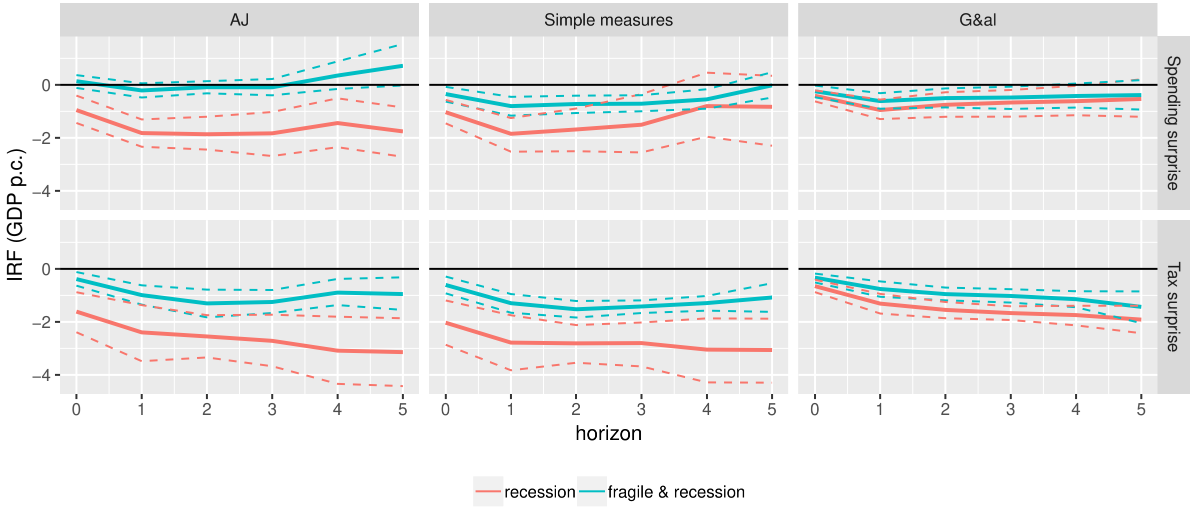

Figure A.2: Response to surprise consolidation in a recession

Note: The plots show impulse response functions for surprise (spending and tax) shocks in models with different fragility measures. Conditioning scenarios are described in Table 2.

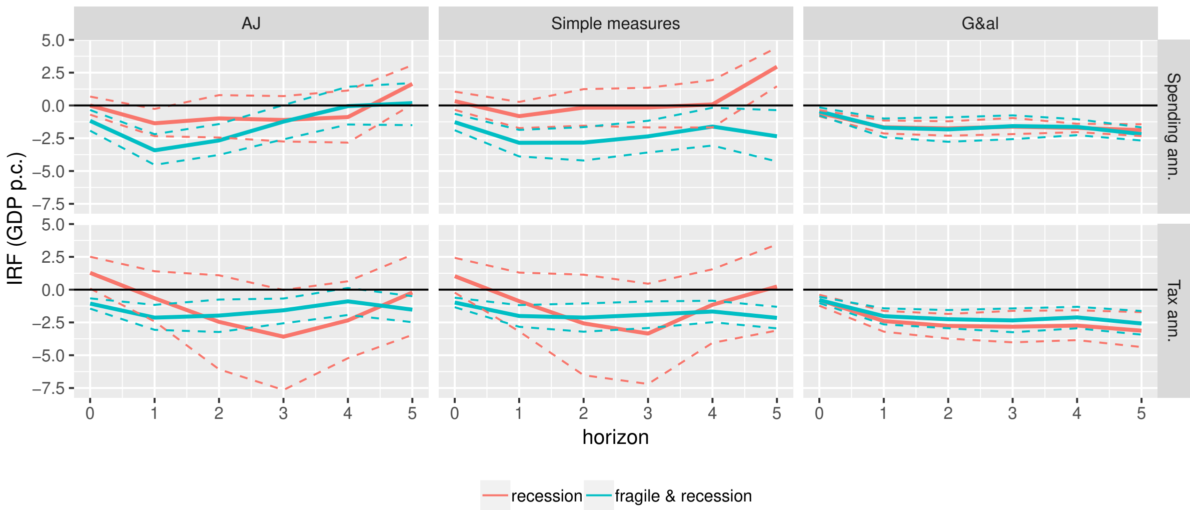

Figure A.3: Response to announcement shocks in a recession

Note: The plots show impulse response functions for (spending and tax) announcement shocks in models with different fragility measures. Conditioning scenarios are described in Table 2.

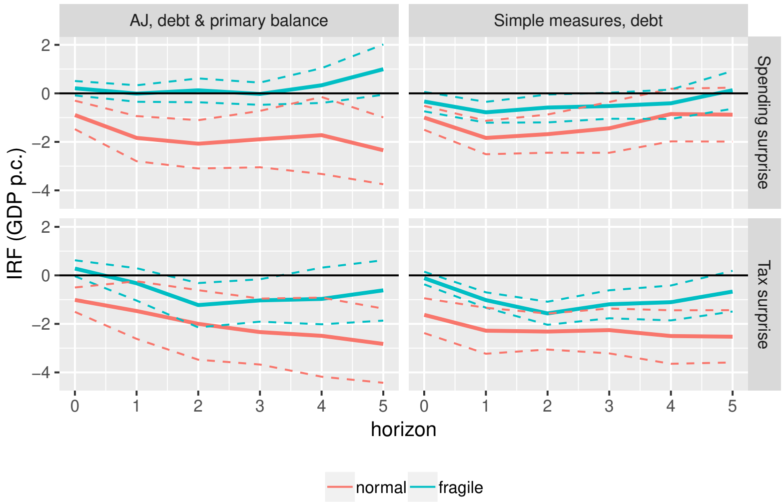

Figure A.4: Response to surprise consolidation with second-order interactions

Note: The plots show impulse response functions for surprise (spending and tax) shocks in models with different fragility measures, including their second-order interactions. Conditioning scenarios are described in Table 2.

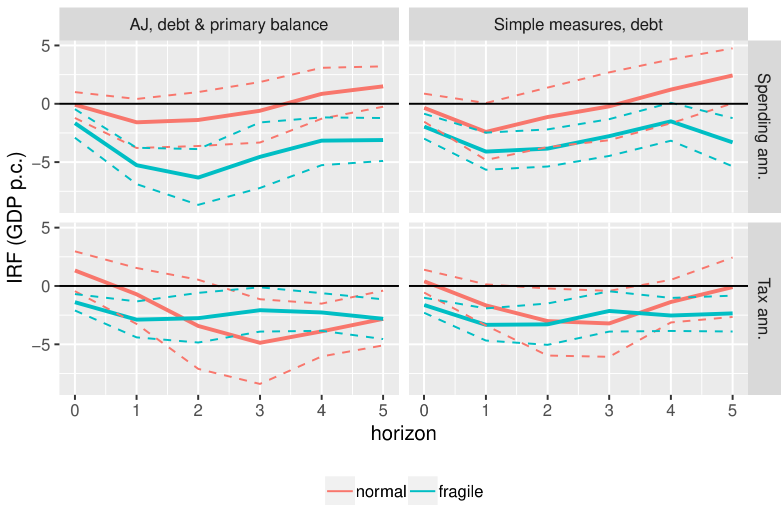

Figure A.5: Response to announcement shocks in a second-order interactions

Note: The plots show impulse response functions for (spending and tax) announcement shocks in models with different fragility measures. Conditioning scenarios are described in Table 2.

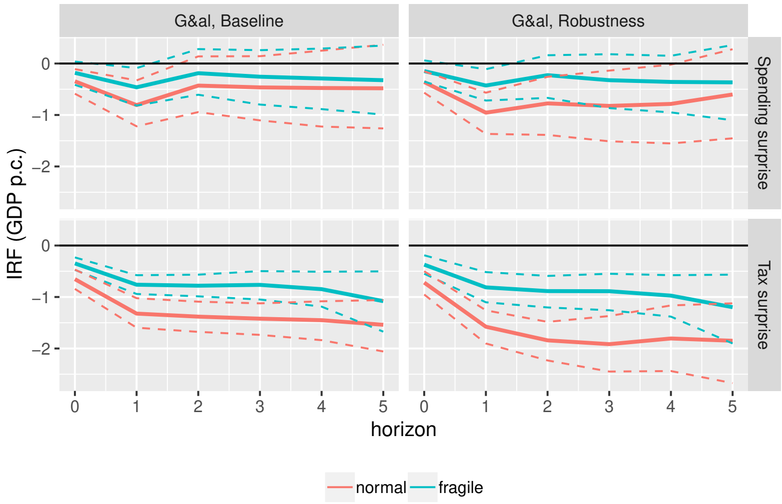

Figure A.6: Response to surprise consolidation for alternative G&al fiscal space measure

Note: The plots show impulse response functions for surprise (spending and tax) shocks for models with alternative fiscal space measures from Ghosh et al. (2013). Conditioning scenarios are described in Table 2.

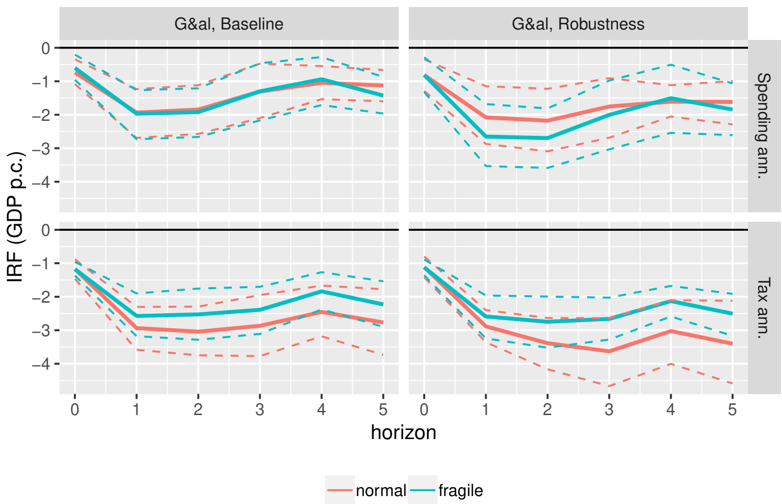

Figure A.7: Response to announcement shocks for alternative G&al fiscal space measure

Note: The plots show impulse response functions for (spending and tax) announcement shocks for models with alternative fiscal space measures from Ghosh et al. (2013). Conditioning scenarios are described in Table 2.