Economica

Phillips Lecture – Why Some Times Are Different: Macroeconomic Policy and the Aftermath of Financial Crises

By Christina D. Romer and David H. Romer

University of California, Berkeley

Analysis based on a new measure of financial distress for 24 advanced economies in the postwar period shows substantial variation in the aftermath of financial crises. This paper examines the role that macroeconomic policy plays in explaining this variation. We find that the degree of monetary and fiscal policy space prior to financial distress—that is, whether the policy interest rate is above the zero lower bound and whether the debt-to-GDP ratio is relatively low—greatly affects the aftermath of crises. The decline in output following a crisis is less than 1% when a country possesses both types of policy space, but almost 10% when it has neither. The difference is highly statistically significant and robust to the measures of policy space and the sample. We also consider the mechanisms by which policy space matters. We find that monetary and fiscal policy are used more aggressively when policy space is ample. Financial distress itself is also less persistent when there is policy space. The findings may have implications for policy during both normal times and periods of acute financial distress.

INTRODUCTION

The aftermath of financial crises varies greatly. Following Japan's crisis in the 1990s, real GDP growth slowed dramatically and persistently; following Norway's crisis around the same time, GDP fell only briefly, and then grew substantially faster than before the crisis. Even following the global financial crisis of 2008—which by definition affected nearly every country in the world—outcomes varied widely. Some countries, such as Australia and South Korea, came through largely unscathed; and even the USA and the UK, where the crisis was particularly severe, started to grow again less than a year after the crisis. Others, such as Italy, Portugal and Greece, remained depressed more than five years after the crisis began.

In this paper, we consider one possible explanation for the variation in aftermaths: a country's ability and willingness to use macroeconomic policy. When Japan's crisis became severe in 1997, it was already at the zero lower bound on the policy interest rate, and its debt-to-GDP ratio was among the highest in the world. Its monetary and fiscal policy responses were decidedly lacklustre—particularly relative to the magnitude of its financial problems. Norway, in contrast, began its crisis with a nominal policy rate close to 10%, and with negative net debt (as a result of its large sovereign wealth fund). Its macropolicy response, including an expensive bailout of its financial system, was swift and aggressive. Following the 2008 crisis, the central banks of the USA and the UK were able to cut interest rates at least somewhat before hitting the zero lower bound. But by the time financial distress became acute in the countries of southern Europe, the policy rate in the euro area was firmly constrained. And countries such as Australia, South Korea, the USA and the UK were able to use fiscal policy aggressively thanks to relatively low debt and high borrowing capacity, whereas Greece's and Italy's high debt levels almost surely limited their ability to use fiscal policy.

Using a new series on financial distress in advanced economies in the postwar period, we test whether economic outcomes following crises vary systematically with the amount

of monetary and fiscal policy space a country possessed prior to distress. We find that GDP falls much less in countries with macropolicy space than in those without. We also investigate the mechanisms by which policy space matters. We find that countries with space use policy—particularly fiscal policy—much more aggressively. Financial distress itself also appears to be much less persistent in countries with room to use policy.

Overview

Section I of the paper reviews the new semi-annual series on financial distress for 24 advanced countries over the period 1967–2012 presented in Romer and Romer (2017). A defining feature of the new series, which is derived from a single real-time narrative source, is that it scales the severity of financial distress. This feature enables us to control for variation in the severity of distress when examining the aftermath of crises. Section I also reviews and extends the evidence from the earlier paper that the aftermath of financial crises, even in otherwise similar modern advanced economies, is highly variable.

Section II examines the role of monetary and fiscal policy space before financial distress in explaining the variation in the aftermath of financial crises. We measure monetary policy space in a variety of ways. The simplest is just a dummy variable for whether the policy rate is above the zero lower bound; more complicated versions take into account participation in a currency union and the fact that the cut-off is likely to be smooth rather than abrupt. Our main measure of fiscal space is the ratio of gross debt to GDP (multiplied by −1 so that higher values correspond to greater space). As alternatives, we consider the ratio based on net debt, as well as specifications that account for possible non-linearities and the effects of being subject to the European Union's fiscal rules. A benefit of looking at policy space before financial distress rather than at actual policy during a crisis is that space is relatively exogenous. Whereas the actual policy response is likely to be affected by the severity of any post-crisis recession, prior policy space is more likely to reflect trend inflation (which affects nominal policy interest rates) or long-run patterns of fiscal prudence or profligacy.

Our basic empirical specification uses the Jordà local projection approach to estimate the response of real GDP at various horizons after time t to financial distress at t. We test for the importance of policy space by including an interaction term between distress and prior policy space. The overwhelming finding from this estimation is that policy space matters. The estimated coefficient on the interaction term is consistently positive and highly statistically significant. The effects are also quantitatively large. For a country with both types of policy space, the decline in output following a financial crisis is effectively zero, whereas for a country without either type of space the decline is large (almost 10%) and highly persistent. Though there is a range of estimated impacts of space depending on the particular measures of policy space used, the finding that monetary and fiscal space matter is highly robust.

Section III of the paper analyses possible mechanisms by which policy space may affect the aftermath of financial crises. Our main focus is on the policy response. We run the same sort of Jordà regressions with interaction terms as in Section II, but with measures of monetary and fiscal policy as the dependent variable. As one might expect, central banks cut policy rates more in response to a financial crisis when they are away from the zero lower bound prior to the distress—though not dramatically so. The fiscal policy response, on the other hand, varies drastically with prior policy space. Countries that face financial distress with debt ratios substantially below average typically engage in aggressive fiscal expansion, whereas countries with high debt loads typically run highly contractionary

fiscal policy following a crisis. Given the widespread evidence that monetary and fiscal policy have substantial real effects, these systematic differences in the policy response depending on policy space likely account for much of the finding that the aftermath of crises tends to be much milder when a country possesses monetary and fiscal policy space.

Section III also examines a second channel through which greater policy space could cushion the adverse effects of financial crises: the persistence of financial distress. For this analysis, we regress distress at various horizons after time t on both distress at t and the interaction of distress and prior policy space. We find that financial distress dies down much more quickly following an innovation when a country has monetary and fiscal policy space. This could be because space allows for policies that stabilize output, which aids financial recovery indirectly, or because space allows for more aggressive government bailouts and restructuring of the financial system. It could also be that crises are less likely to mushroom and spread if people see that the government possesses the ability to rescue the economy and financial institutions. Whatever the particular channel, the fact that distress is less persistent when there is macropolicy space could help to account for the positive relationship that we find between economic activity and policy space following financial crises.

Finally, Section IV discusses the possible implications of the results for policy. Our finding that policy space matters substantially for the aftermath of financial crises strongly suggests that if countries want to be able to combat future crises, then they should aim to maintain policy space in normal times. This could involve higher normal inflation, so that monetary policymakers have more room to cut interest rates in a crisis, and more prudent fiscal policy in normal times, so that debt loads are typically low.

Related literature

Relatively little previous work speaks directly to the issues that are the focus of this paper. There is, of course, a voluminous literature on financial crises; see, for example, Kaminsky and Reinhart (1999), Bordo *et al.* (2001), Reinhart and Rogoff (2009), Jordà *et al.* (2013), and Laeven and Valencia (2014). Much of this research focuses on identifying crises and examining the output consequences.

Some of the research on crises examines the behaviour of a broad range of variables, including policy indicators, around the times of financial crises. For example, Reinhart and Rogoff (2009, chs 10, 14) show that government debt as a share of GDP often rises sharply following crises—in considerable part because of high deficits stemming from large falls in revenue. But they do not ask how the behaviour of debt varies with the country's prior fiscal space or how the aftermath of crises varies with the fiscal response. Similarly, in recent work, Kose *et al.* (2017) present multiple measures of fiscal space and discuss how space behaves around financial crises, but they do not examine the link between policy space and the aftermath of crises that is the focus of this paper.[1]

On the fiscal policy side, the issues of how the level of government debt affects both the conduct of policy and fiscal multipliers are potentially relevant to how the aftermath of financial crises varies with government debt. A line of research begun by Bohn (1998) and extended by such authors as Mendoza and Ostry (2008) finds that the stance of fiscal policy is on average more expansionary when government debt is lower. But this work does not focus on the question of how debt affects the response of fiscal policy to shocks. And papers such as Perotti (1999), Corsetti *et al.* (2012) and Ilzetzki *et al.* (2013) investigate whether fiscal multipliers vary with the level of debt. However, because we find that the fiscal response to a financial crisis is highly contractionary in high-debt

countries and highly expansionary in low-debt countries, the answer to this question does not appear central to understanding why the aftermath of a financial crisis is typically so much worse in high-debt countries.

Finally, many observers have stressed that monetary and fiscal policy space can affect the policy response to adverse macroeconomic shocks, and hence the output effects of the shocks. Moreover, some of this work focuses on how space can be important to the response to financial crises in particular. On the monetary policy side, Amano and Shukayev (2012) show in a calibrated model that the times when the zero lower bound is likely to cause particularly large output losses are when there are shocks that trigger a financial crisis, and hence that monetary policy space may be particularly important to the effects of crises. On the fiscal policy side, Obstfeld (2013) argues that the continued large scale and complexity of the financial system makes future financial crises likely, and that low government debt makes it easier for policymakers to use fiscal policy to respond to crises. Neither paper, however, presents direct empirical evidence about the impact of policy space on output losses from crises.

I. New Measure of Financial Distress and the Aftermath of Crises

In Romer and Romer (2017), we describe the derivation of a new scaled measure of financial distress, and provide evidence that the aftermath of financial crises is highly variable. Since both of these contributions are essential inputs to this study, it is useful to summarize them briefly.

New measure of financial distress

Conceptually, our new measure of financial distress is designed to capture what Bernanke (1983) calls a rise in the cost of credit intermediation. It focuses narrowly on the health of the financial system, rather than on currency or sovereign debt markets. It seeks to identify times when credit provision became more costly relative to a safe interest rate. Such a rise in the cost of credit intermediation results in a reduction in credit supply for a given level of borrower riskiness.

We identify such increases in the cost of credit intermediation for 24 advanced countries in the postwar period from a single real-time narrative source prepared by analysts at the Organisation for Economic Co-Operation and Development (OECD): the *OECD Economic Outlook* (OECD, various years). The *OECD Economic Outlook* provides concise, analytical descriptions of economic and financial conditions in each OECD country twice a year (roughly June and December) beginning in 1967. To identify increases in the cost of credit intermediation from this source, we read the entries looking for descriptions of higher funding costs (relative to a safe interest rate), losses of confidence in financial institution or the existence of factors likely to impair confidence (such as rising loan defaults or erosion of banks' capital), and increased information costs (say, because of widespread bank failures). We also look for narrative descriptions of resulting credit rationing and other direct indications of disruption to the supply of credit. Because the *OECD Economic Outlook* is available twice a year, our new measure of financial distress is semi-annual as well.

A key feature of the new series is that it is scaled from 0 to 15. Zero corresponds to no indication of financial distress; low positive numbers correspond to relatively minor amounts of credit disruption; and high numbers correspond to severe financial crises and the breakdown of intermediation. As discussed in detail in Romer and Romer (2017), we

scale financial distress by looking for gradations in the narrative indicators of increases in the cost of credit intermediation. The descriptions that we classify as a 7 or above appear to correspond approximately to what other crisis chronologies call a systemic crisis. In such episodes, there are substantial problems in the financial sector; these problems are central to the macroeconomic outlook; and the government is likely to be taking emergency actions to stabilize financial markets and restore credit flows.

As described in the previous paper, we take various steps to ensure the independence and accuracy of the new series. For example, we were careful not to consult data on outcomes before our narrative work was complete, and we provide a detailed description of our reasoning for each positive scaling of distress so that others can check our analysis. We also check the distress series based on the *OECD Economic Outlook* against a range of other narrative sources. While the alternative sources do not match the OECD in every instance, they are reassuringly close.

Figure 1 shows the new measure of financial distress for the 24 countries in our sample from 1967 (when the *OECD Economic Outlook* begins) to 2012. The most obvious characteristic is that there was essentially no financial distress in OECD countries in the first 20 years of the sample. This finding is consistent with the notion that the financial
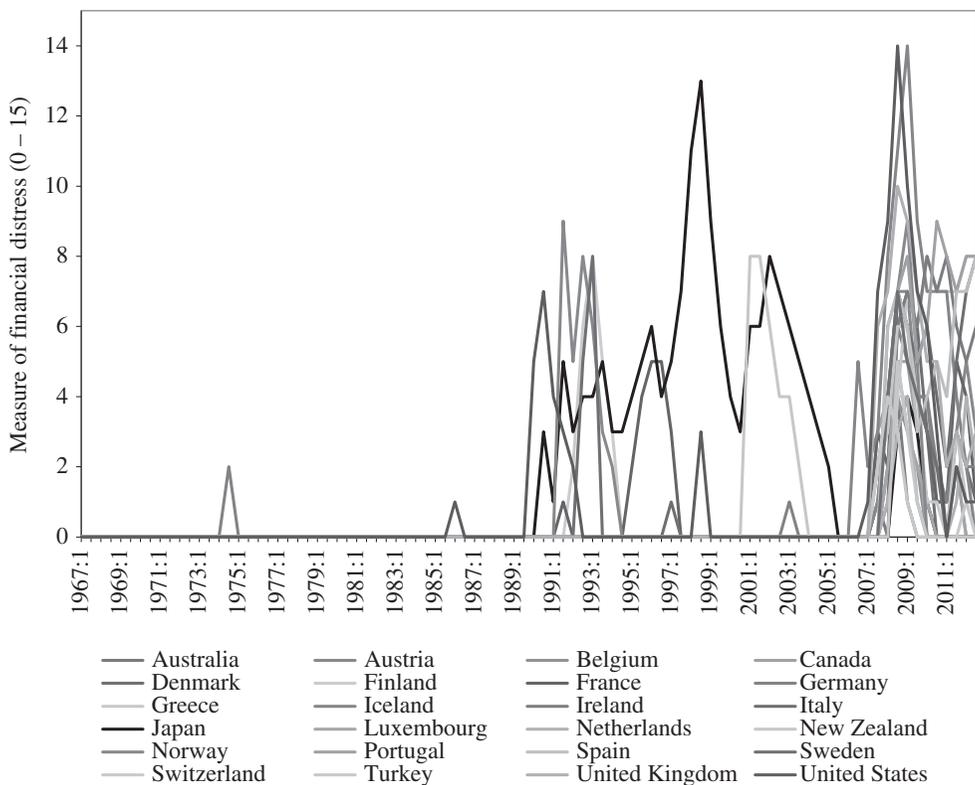

FIGURE 1. New measure of financial distress.
Notes: See Romer and Romer (2017) for the details of the derivation of the new measure. The data are available semi-annually from 1967:1 to 2012:2. In the new measure, 0 corresponds to no financial distress; 1, 2 and 3 correspond to gradations of credit disruptions; 4, 5 and 6 to gradations of minor crises; 7, 8 and 9 to gradations of moderate crises; 10, 11 and 12 to gradations of major crises; and 13, 14 and 15 to gradations of extreme crises.

architecture of advanced economies in the early postwar period was highly regulated and extraordinarily stable. There was substantial financial distress in the USA and the Nordic countries in the late 1980s and early 1990s. Japan experienced financial distress continuously between 1990 and 2005—some of it extremely severe. Finally, during the 2008 global financial crisis, every country in our sample had at least some financial distress—though the level varied greatly across countries.

The average aftermath of financial crises

As described in our earlier paper, to summarize how real GDP typically behaves following financial distress, we use the Jordà (2005) local projection method. We regress the logarithm of real GDP at various horizons after time t on financial distress at t. Because we have a panel of semi-annual data for 24 countries, we include time and country fixed effects. To capture other dynamics, we also include four lags of both GDP and financial distress. Thus the equation that we estimate is

$$(1) \qquad y_{j,t+i} = \alpha_j^i + \gamma_t^i + \beta^i F_{j,t} + \sum_{k=1}^{4} \varphi_k^i F_{j,t-k} + \sum_{k=1}^{4} \theta_k^i y_{j,t-k} + e_{j,t}^i,$$

where the j subscripts index countries, the t subscripts index time, and the i superscripts denote the horizon (half-years after time t) being considered. $y_{j,t+i}$ is the logarithm of real GDP for country j at time $t+i$. $F_{j,t}$ is the financial distress variable for country j at time t. The α terms are country fixed effects, and the γ terms are time fixed effects. We estimate (1) separately for horizons 0 to 10 (that is, up to five years after time t). The sequence of β^i coefficients from these eleven regressions provides a non-parametric estimate of the impulse response function of output to financial distress.

As discussed in detail in the previous paper, this specification includes as part of the average aftermath of distress any contemporaneous relationship between output and distress. Because distress is almost surely at least somewhat endogenous, the resulting point estimates should thus be viewed as an upper bound of any causal effect of distress on economic activity.

The data on real GDP for each country come from the OECD.[2] The OECD makes some adjustments; for example, all of the series are on the same base year and denominated in 2010 dollars. However, the series are ultimately constructed by each country's statistical agency, so may not be strictly comparable. Because the financial distress variable is semi-annual (corresponding roughly to June and December), we convert the GDP data to semi-annual as well (using the observations for the second and fourth quarters of each year).

The policy measures that we use in Sections II and III are generally not available before 1980. For comparability with later results, in estimating equation (1), we also use only data beginning in 1980:1. The new measure of financial distress is available through 2012:2, and we use GDP data through 2015:2. As a result, the regressions for longer horizons make use of the later GDP data, while those for shorter horizons do not.

Figure 2 shows the estimated response of GDP to an innovation of 7 in our new measure of financial distress.[3] A 7 corresponds to the lower end of the moderate crisis category on our scale. The figure shows that, on average, GDP falls roughly 6% following a financial crisis, and the effects are highly significant and quite persistent.[4] More than one-third of the decline occurs in the contemporaneous half-year—when
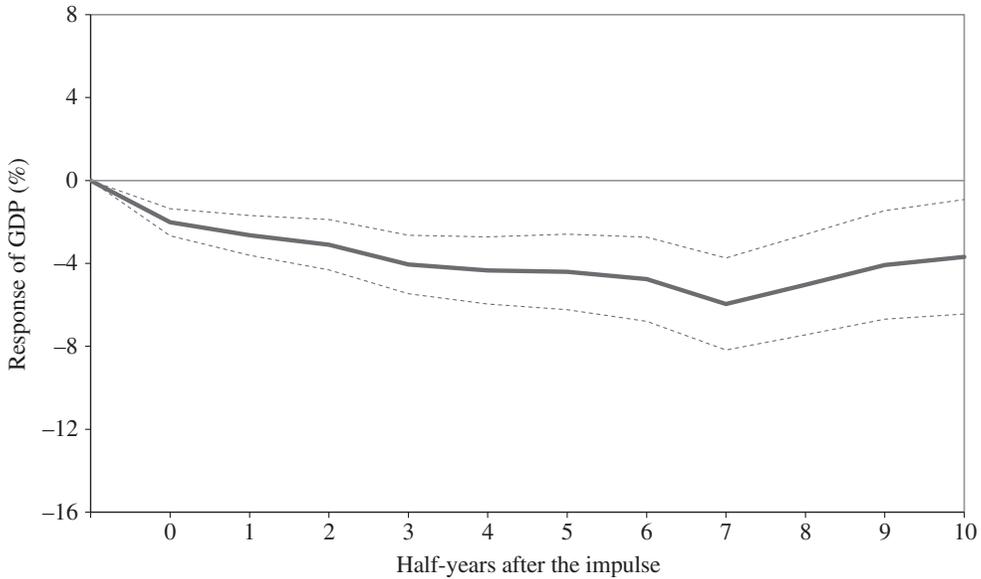
FIGURE 2. Behaviour of real GDP after a financial crisis.

Notes: The figure shows the impulse response function for real GDP to an impulse of 7 in our new measure of financial distress derived from estimating equation (1) for the sample of 24 OECD countries over the post-1980 period using OLS. The dashed lines show the two-standard-error confidence bands.

reverse causation is most likely. Though the estimated average decline is unquestionably substantial, it is perhaps somewhat smaller than the literature on the dire consequences of financial crises might lead one to expect.

Variation in the aftermath of financial crises

To investigate the variation in the aftermath of financial crises, we focus on episodes of substantial distress. There are nineteen times when a country in our sample has a distress reading of at least a 7.[5] For these episodes, we construct a simple forecast for the logarithm of real GDP and look at the forecast errors. We interpret substantial differences in the forecast errors as evidence of variation in aftermaths.

To form the relevant forecast for each episode, we begin with the estimated coefficients from equation (1) for the full sample of countries in the post-1980 period. We then use actual GDP in the country up to one half-year before financial distress first reached 7 (or above), and actual distress up to the half-year when it reached that benchmark. Because we control for the initial level of distress (and lags) in the forecast, the mean forecast errors across these crisis episodes are roughly zero, rather than negative as one might expect.[6]

Figure 3 shows the forecast errors for the nineteen episodes, grouped into three categories. Panel A shows the nine cases where the forecast errors are positive or just barely negative. These are times when the aftermaths are decidedly better than predicted (conditional on there being significant distress). Even within this category there is substantial variation: for example, the positive forecast errors for Norway in its 1991 crisis top 12%; those for Denmark in the 2008 crisis reach a maximum of less than 3%. Panel B shows the four cases of moderately negative forecast errors. Again, within this
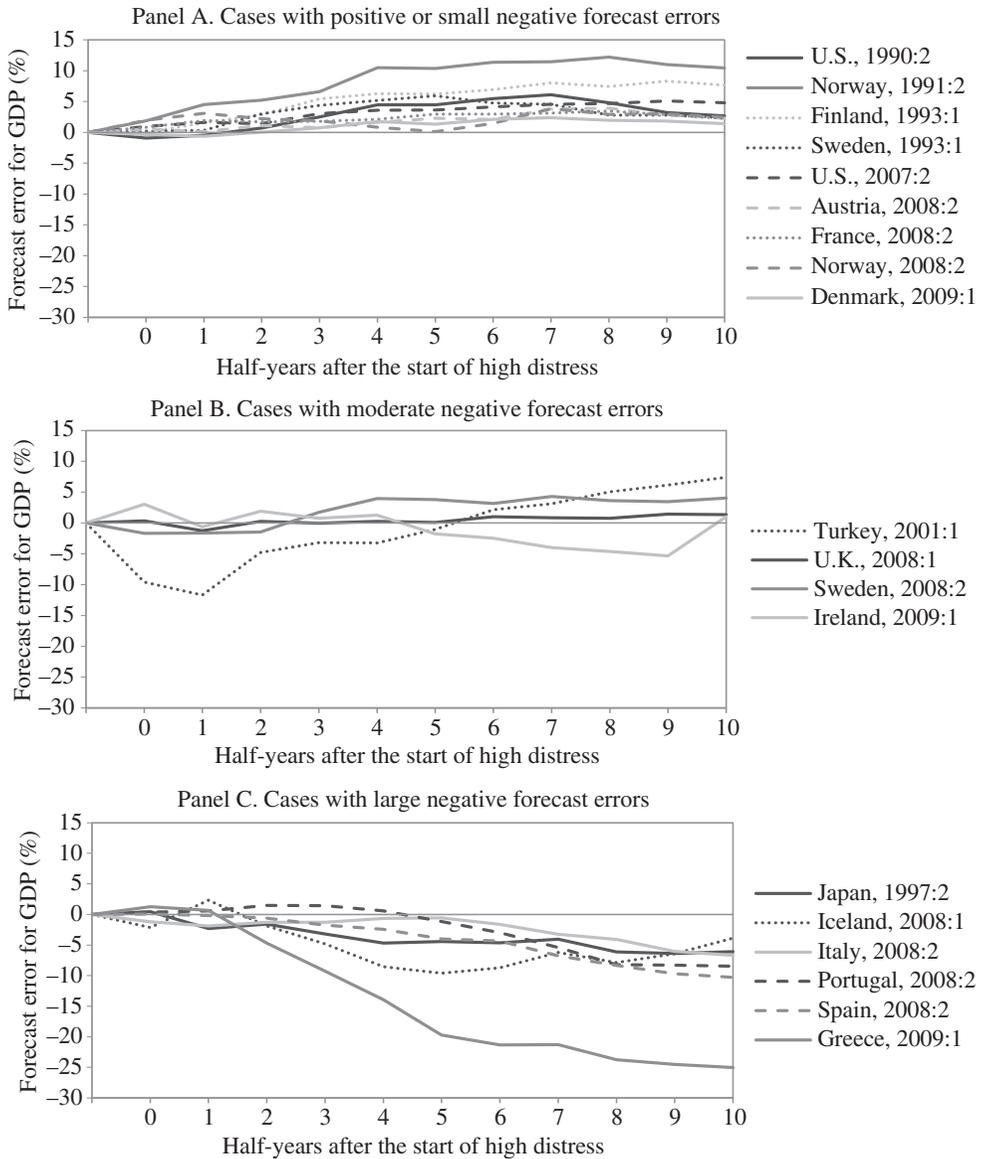
Panel A. Cases with positive or small negative forecast errors

Panel B. Cases with moderate negative forecast errors

Panel C. Cases with large negative forecast errors

FIGURE 3. GDP forecast errors for episodes of high financial distress.
Notes: The panels show the forecast errors for real GDP (defined as actual minus forecast) following episodes of significant financial distress. The dates given are when distress first reached 7 or above. We estimate equation (1) over the full sample, and then construct forecasts using actual GDP data up to one half-year before distress reached 7 and actual distress up to when distress reached 7.

broad category there is great variety: for example, Sweden following the 2008 crisis initially had modest negative forecast errors, which were followed by substantial positive ones; Ireland, also following the 2008 crisis, initially had positive forecast errors, which were followed by negative ones of more than 5%. Finally, panel C shows the six episodes with large negative forecast errors. These are times when the outcomes were far worse

than predicted. In all cases the negative forecast errors have a maximum of over 6%; in the case of Greece, the maximum is over 25%.

Figure 3 makes it clear that even conditional on the initial severity of distress, actual outcomes relative to the ones predicted vary enormously. In some cases output rises rapidly relative to the forecast, whereas in others output not only plummets relative to the forecast, but continues falling for years. The fact that the aftermath of crises varies so greatly across episodes suggests that it is crucially important to try to understand the source of this variation.

II. THE ROLE OF MACROECONOMIC POLICY SPACE IN ACCOUNTING FOR THE VARIATION IN THE AFTERMATH OF FINANCIAL CRISES

The possible explanation on which we focus in this paper is the contribution of macroeconomic policy. The first and most important thing that we look at is the role of macroeconomic policy space in accounting for the variation in the aftermath of financial crises. By macropolicy space, we mean the room that policymakers have to manoeuvre. For example, if the policy interest rate is well above zero when a crisis starts, then the central bank will have much greater ability to use conventional monetary policy to deal with the effects of a crisis than if the country begins the crisis at the zero lower bound. Similarly, if a country begins a crisis with a low debt-to-GDP ratio, then policymakers are more likely to be able to bail out the financial system or to use fiscal stimulus to cushion the impact of the crisis than if the debt load at the start of the crisis is already high.

An important reason for looking at macropolicy space rather than at the policy response directly is that the results are much less likely to be affected by endogeneity. We would expect a country facing a more severe recession following a crisis to use policy more aggressively. As a result, one might find that crises accompanied by a more aggressive policy response have worse aftermaths—but causation would likely run from the aftermath to policy, not the other way around. Policy space before the crisis, on the other hand, is more likely to be driven by fundamentals. Is a country typically fiscally prudent (like Germany), or fiscally profligate (like Greece)? Does a country typically have moderate inflation, so nominal interest rates hover well above the zero lower bound (like the Nordic countries in the 1980s and 1990s), or very low inflation, so nominal rates are typically low (like Japan in the 1990s and after)?

At the same time, we expect policy space to be correlated with the policy response. Indeed, in Section III we provide direct evidence of this. So looking at policy space can capture the likely contribution of policy, while avoiding at least some of the endogeneity issues.

Monetary policy space

We start with the contribution of monetary policy space, and then consider fiscal policy space. We also consider the explanatory power of the two types of space together.

Measures of monetary policy space There are various ways to measure monetary policy space. All of them begin with data on the level of the policy interest rate in each country. Because such policy rates vary over time and across countries, collecting these series is not as straightforward as one might expect. In all cases, we focus on a market rate (such as the federal funds rate), rather than an administered rate (such as the discount rate). We collect the policy rate data from the relevant central bank when they are available.

We supplement these data with related data on interbank interest rates. To convert the data to a semi-annual series, we use the observation at the end of the half-year. The Data Appendix provides a detailed description of the sources, series and splicing procedures used for each country in our sample.

The simplest measure of monetary policy space (and the one that we use as our baseline) is just a dummy variable that is equal to 1 if the policy interest rate is greater than 1.25% at the end of the *previous* half-year, and 0 otherwise. Though the particular cut-off level is admittedly somewhat arbitrary, this measure captures the notion that if the policy interest rate is at or below 1.25%, policymakers are severely limited in how much they can use conventional monetary policy. We define the dummy based on the level of the policy rate at the end of the previous half-year to limit the endogeneity of the measure of policy space with respect to financial distress and economic activity.

We consider variants of this simple measure along three dimensions. The first is simply to consider other cut-offs. For example, perhaps an initial policy interest rate of 2% is also functionally equivalent to being at the zero lower bound.

The second variant is to take into account the fact that the cut-off between not having and having space is surely not as sharp as a dummy variable implies. When it comes to being able to respond to a crisis, starting at a policy interest rate of 1% is probably not very different from starting at 1.5%. For this reason, we also consider functions that, rather than transitioning abruptly from 0 to 1 at some cut-off interest rate, transition smoothly around some rate. For convenience, the functional form that we use is the cumulative normal distribution. For example, using a cumulative normal distribution with mean 1.25% and standard deviation 0.625%, the measure of space is essentially 0 at a policy rate of 0 or less, 0.16 at a policy rate of 0.625%, 0.5 at 1.25%, 0.84 at 1.875%, and essentially 1 at 2.5% or more. The smoothed measure could capture any reason for the transition not being sharp. One concrete way to interpret it is as the probability that the policy response will not be constrained. We consider a range of possible means and standard deviations of the cumulative normal distribution, including some that imply that the transition from no space to space is quite gradual.[7]

The third variant involves the treatment of the euro area, which accounts for half of the countries in our sample in the latter part of the sample period. Even if the policy rate of the European Central Bank (ECB) is not at zero, for a particular euro area country the rate is likely to be relatively unresponsive to country-specific conditions. We therefore consider an alternative form of the simple dummy variable that is 1 if the country has a policy rate above 1.25% *and* is not in the euro area.

We also consider a more complicated approach that takes into account the fact that while the ECB cannot set a separate policy interest rate for each member country in response to that country's financial distress, it may be able to respond to general euro area distress. The way in which we model this feature of policy is to decompose distress in each euro area country in the period when the euro is in effect into two components: the weighted average of distress in the euro area as a whole, and the deviation of distress in that country from the average. The weights are based on each country's GDP in the first half-year of 2006 (which is the midpoint of the period in our sample after the introduction of the euro). We then assume that monetary policy may respond to the first component as long as the ECB's policy rate is not constrained by the zero lower bound (which, as before, we define as corresponding to a policy rate above 1.25%), but that it does not respond to the second component regardless of the policy rate.

Specification and results Section I described the basic regression framework that we use to look at the aftermath of financial distress. We regress output at various horizons after time t on distress at t, along with lags of both output and distress, and country and time fixed effects. To account for possible interaction effects with monetary policy space, we simply add an interaction term between financial distress at time t and the measure of monetary policy space, also at time t (which as described before, is based on the policy rate at the end of period $t - 1$). We also include the level of the policy space measure to account for any systematic difference between countries with and without space in normal times. And we again include four lags of all variables. Thus the equation that we estimate is

$$
\begin{aligned}
y_{j,t+i} = {} & \alpha_j^i + \gamma_t^i + \zeta^i S_{j,t} + \beta^i F_{j,t} + \delta^i (F_{j,t} \cdot S_{j,t}) \\
& + \sum_{k=1}^{4} \rho_k^i S_{j,t-k} + \sum_{k=1}^{4} \varphi_k^i F_{j,t-k} + \sum_{k=1}^{4} \omega_k^i (F_{j,t-k} \cdot S_{j,t-k}) + \sum_{k=1}^{4} \theta_k^i y_{j,t-k} + e_{j,t}^i,
\end{aligned}
$$

(2)

where $y_{j,t+i}$ is again the logarithm of real GDP for country j at time $t + i$, $F_{j,t}$ is financial distress in country j at time t, the α and γ terms are country and time fixed effects, respectively, and $S_{j,t}$ is a measure of policy space for country j at time t.

Equation (2) makes clear that policy space is allowed to evolve as financial distress progresses. That is, as t changes, policy space changes. As a result, the specification captures the fact that as distress persists, macroeconomic policy space may change. However, because policy space is defined in terms of the policy rate at the end of the previous half-year, it is always lagged relative to distress.

We again estimate the equation for horizons 0 to 10. As in Section I, we use data beginning only in 1980, and the end date varies with the particular horizon being considered because the output data are available through 2015:2. For our baseline case, we measure monetary policy space using the simple dummy variable equal to 1 if the policy interest rate is greater than 1.25% at the end of the previous half-year.

The results of estimating equation (2) suggest that monetary policy space matters substantially. The estimated coefficient on the interaction term (δ^i) is strongly positive and significant at all horizons after one half-year. Indeed, for horizons of 3 to 8 half-years, the t-statistic on the interaction term ranges from 2.5 to 3.7. Thus the aftermath of financial distress is significantly better when a country begins the period of distress with monetary policy space.

Figure 4 summarizes the results by plotting the impulse response function for GDP to a realization of our financial distress measure of 7 (a moderate crisis) in two cases. 'Without monetary policy space' corresponds to the case where the dummy variable is equal to 0; 'with monetary policy space' corresponds to the case where the dummy variable is equal to 1.[8] The figure shows that the fall in GDP following substantial financial distress is dramatically smaller when a country has monetary policy space than when it does not. At most horizons, the difference is 4 to 6 percentage points. The peak decline is 9.5% when there is not monetary policy space, but just 3.0% when there is.

Figure 4 also shows the two-standard-error confidence bands for the two impulse response functions (based on conventional standard errors). At intermediate horizons they do not overlap at all. Importantly, however, the confidence bands reflect uncertainty about both the average decline in GDP following financial distress and how the decline varies with policy space. Therefore the appropriate way to test whether the responses
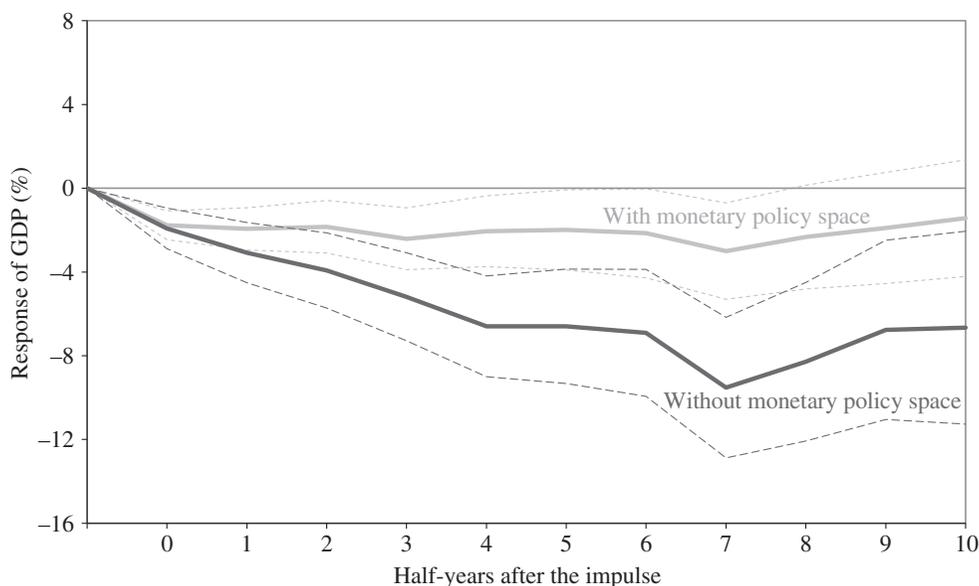
FIGURE 4. Behaviour of real GDP after a financial crisis, with and without monetary policy space.
Notes: The figure shows the impulse response function for real GDP to an impulse of 7 in our new measure of financial distress derived from estimating equation (2) for the sample of 24 OECD countries over the post-1980 period using OLS. The measure of monetary policy space used is a dummy variable equal to 1 if the policy interest rate is greater than 1.25% at the end of the previous half-year. The 'without monetary policy space' line corresponds to a value of the dummy of 0; the 'with monetary policy space' line corresponds to a value of the dummy of 1. The dashed lines show the two-standard-error confidence bands.

with and without policy space are different is to look at the statistical significance of the estimated coefficients on the interaction term, not whether the confidence bands overlap. As discussed above, those coefficients are highly significant.

An example that illustrates the importance of this interaction effect is Japan following its severe financial distress in the late 1990s. Recall that in the forecasting exercise discussed in Section I, Japan stands out as a case where the forecast errors are large and negative. The behaviour of output following its crisis was substantially worse than the prediction conditional on lagged output, lagged distress, and the level of distress at the start of the crisis.

Importantly, Japan had been struggling with slow growth and low inflation following the bubble and bust of real estate prices around 1990. As a result, when financial distress became acute in 1997, monetary policy had nowhere to cut. To see the impact of being at the zero lower bound, we now consider a forecast based on our parameter estimates from equation (2). In constructing the forecast for a particular episode, we use actual output up to one period before distress reached 7, and monetary policy space, distress, and the interaction between distress and policy space up to the period when distress reached that level. We compare this to the forecast based on an equation that excludes the interaction terms (but for comparability includes the level of monetary policy space).

The two forecasts for Japan are shown in Figure 5. Accounting for the interaction with monetary policy space results in noticeably smaller negative forecast errors than the simple forecast.[9] In this episode, much of the reason why the aftermath was worse than
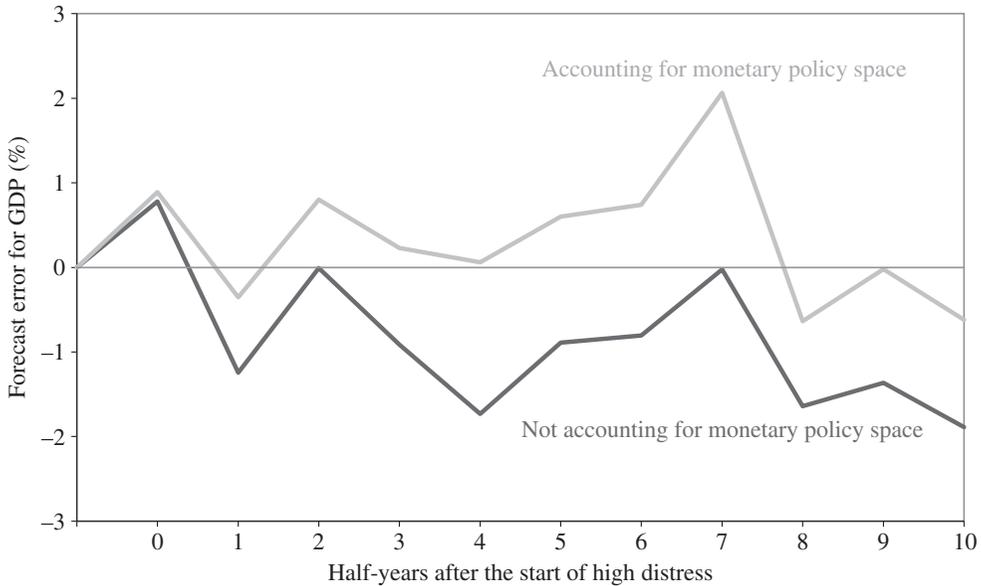
FIGURE 5. GDP forecast errors for Japan following the 1997:2 crisis, accounting and not accounting for monetary policy space.

Notes: The figure shows the forecast errors for real GDP (defined as actual minus forecast) following the financial crisis in Japan. In this episode, financial distress first reached 7 or above in 1997:2. The measure of monetary policy space used is a dummy variable equal to 1 if the policy interest rate is greater than 1.25% at the end of the previous half-year. The forecast accounting for monetary policy space is derived by estimating equation (2) over the full sample, and then using actual GDP data up to one half-year before distress reached 7, and the measure of monetary policy space, the interaction term, and actual distress up to when distress reached 7. The forecast not accounting for monetary policy space is derived in the same way, except that the interaction term (both the contemporaneous value and lags) between monetary policy space and financial distress is omitted from both the equation that is estimated and the construction of the forecast.

one would predict based on lagged output and initial distress is that Japan lacked monetary policy space.

Robustness The finding that the aftermath of financial distress is decidedly better when a country has monetary policy space is highly robust to the measure of monetary policy space used. For example, raising the cut-off for the simple dummy variable for space from 1.25% to 2% weakens the results only slightly. The estimated coefficient on the interaction term is consistently positive and significant for horizons 4 to 8. The maximum decline in GDP following an impulse in financial distress of 7 is 8.2% when there is not monetary policy space and 3.7% when there is.

Similarly, treating the transition from not having to having monetary policy space as gradual rather than sudden has little effect on the results. If we model the transition as smooth around an interest rate of 1.25% (concretely, if we consider the case described above of a cumulative normal distribution function with mean 1.25% and standard deviation 0.625%), then the estimated coefficient on the interaction term is positive after horizon zero and significant for horizons 4 to 8. The maximum decline in GDP following a crisis is 10.1% without monetary policy space, and 3.9% with space.[10] Even moving to a much smoother case does not change the estimates greatly. For example, we also consider the case of a cumulative normal distribution function with mean 3% and

standard deviation 1.5%—which implies that monetary policy is not effectively fully unconstrained until the policy rate is 6% or higher. In this case, the maximum decline in output following a financial crisis is 8.8% without monetary policy space, and 3.2% with space. The coefficient on the interaction term is positive after horizon 1 and statistically significant for horizons 4 to 9.

Taking into account that being in the euro area reduces the ability of monetary policy to respond to a financial crisis in a country yields slightly different, but qualitatively similar results. For example, when we change the monetary policy variable that we interact with financial distress to be 1 only when the policy rate is above 1.25% and the country's monetary policy is not determined by the ECB, the estimated coefficient on the interaction term is positive and strongly significant at all horizons after 3 half-years. The maximum decline in GDP following an impulse to financial distress of 7 is 7.8% without monetary space and 2.6% with space.[11] And when we modify the specification to allow euro area monetary policy to respond to the overall level of distress in the euro area but not to country-specific distress, the corresponding figures are 7.6% and 3.2%.[12] The coefficient on the interaction term is somewhat less precisely estimated, but still significant at horizons 4 to 8.

Returning to our baseline measure of monetary policy space (the simple dummy variable), we also consider samples that leave out particular countries. For example, one might worry that Japan, one of the most famous cases of a country facing a crisis at the zero lower bound, is driving some of the results. But the results are in fact very robust to the sample of countries considered. Indeed, when Japan is excluded, the difference in the aftermath of financial crises with and without monetary policy space actually gets larger: without space, GDP declines 12.3% following an impulse of 7 in financial distress; with space it declines just 3.0%. The estimated coefficient on the interaction term is highly significant at all horizons after 1 half-year.

Fiscal policy space

We now consider the interaction between the aftermath of crises and fiscal policy space.

Measures of fiscal policy space Our measures of fiscal space begin with data on the ratio of gross and net debt to GDP for the 24 countries in our sample. Like the policy interest rate data, these fiscal indicators must be gathered from multiple sources. As discussed in detail in the Data Appendix, we use data from the International Monetary Fund (IMF) when available, and supplement them with comparable data from the OECD when those series go back further in time. The series are spliced together in levels. The debt data are annual; we convert them to semi-annual by assigning the annual value to each of the two half-years.

We use as our baseline measure of fiscal policy space the ratio of gross government debt to GDP in the *previous* calendar year. The idea is that a country with a lower debt-to-GDP ratio is more likely to be able to use fiscal policy than a country with a higher debt-to-GDP ratio. So that the measure of fiscal space has the same sign convention as the monetary policy space variables (where a higher number corresponds to more space), we multiply the debt-to-GDP ratio by −1. Thus a lower debt ratio is a larger number and so corresponds to more space. Using the debt-to-GDP ratio in the previous year limits the endogeneity of fiscal space with respect to output and current fiscal policy.

One alternative measure of fiscal space that we consider is the net debt-to-GDP ratio (again multiplied by −1). Net debt includes government asset holdings, such as a

sovereign wealth fund. Presumably, a country with high government asset holdings (and so lower net debt) has more fiscal space for a given amount of gross government debt than a country without such asset holdings. One limitation of the net debt series is that there are somewhat more missing observations than for gross debt. Another is that the very large negative values of net debt in Norway and Finland may cause the observations from those two countries to have a disproportionate effect on the results.

Another alternative measure takes into account the possibility that fiscal space may not fall linearly with the debt-to-GDP ratio over the entire relevant range. For example, perhaps at some point a higher debt ratio does not matter because fiscal space is already effectively zero. To capture this possibility, we consider a measure of fiscal space that has much in common with our smoothed measure of monetary policy space. Specifically, we let fiscal space be a non-linear function of the debt-to-GDP ratio, using a cumulative normal distribution with a given mean and standard deviation for the functional form. As before, we multiply the measure by −1, so that a larger number corresponds to more space. Though we consider various means and standard deviations, the case that we focus on with this measure sets the mean and standard deviation at the mean and standard deviation of the debt-to-GDP ratio for our sample. These parameters imply that at a debt-to-GDP ratio of roughly 130%, fiscal policy space has essentially reached its lowest possible value.[13]

A factor in addition to debt loads that may affect some countries' ability to use fiscal policy is the European Union's Stability and Growth Pact (SGP), which limits the allowable deficits and debt levels of its members. Although the enforcement of the SGP rules is far from complete, the rules may nonetheless affect the fiscal policy response to financial distress. We therefore also consider specifications that include two measures of fiscal space rather than one. In these cases, the second measure is a dummy variable for not being subject to the SGP. Concretely, it is a dummy equal to 0 for members of the European Union starting in 1999:1 (when the main SGP rules went into effect) and 1 otherwise.[14]

Specification and results Armed with these measures of fiscal space, we can test whether the output consequences of financial distress depend on a country's ability to use fiscal policy. To do this, we estimate equation (2) using a measure of fiscal policy space as the S variable. That is, we regress real GDP at various horizons on distress at time t, also including the interaction of distress and fiscal space (which, as mentioned before, is based on debt figures for the previous calendar year). Paralleling our approach to monetary policy, we also include the level of fiscal space (as well as lags of all variables). As described above, we use the negative of the gross-debt-to-GDP ratio as our baseline measure of fiscal policy space.

The estimates indicate that fiscal policy space also matters greatly. The estimated coefficient on the fiscal policy space interaction term is strongly positive and highly statistically significant for all horizons after horizon 0 (with t-statistics ranging from 2.8 to 4.1). That is, as the debt-to-GDP ratio falls (so fiscal space rises), the aftermath of financial distress is better.

Figure 6 summarizes the results by showing the impulse response function to a realization in distress of 7 with and without fiscal space. Because the fiscal policy space variable entered in the regression is continuous, for this reporting exercise it is less obvious than with the monetary policy space dummy variable what the two categories correspond to. For convenience, we define 'without fiscal space' as corresponding to a value of the debt-to-GDP ratio one standard deviation above the sample average, and
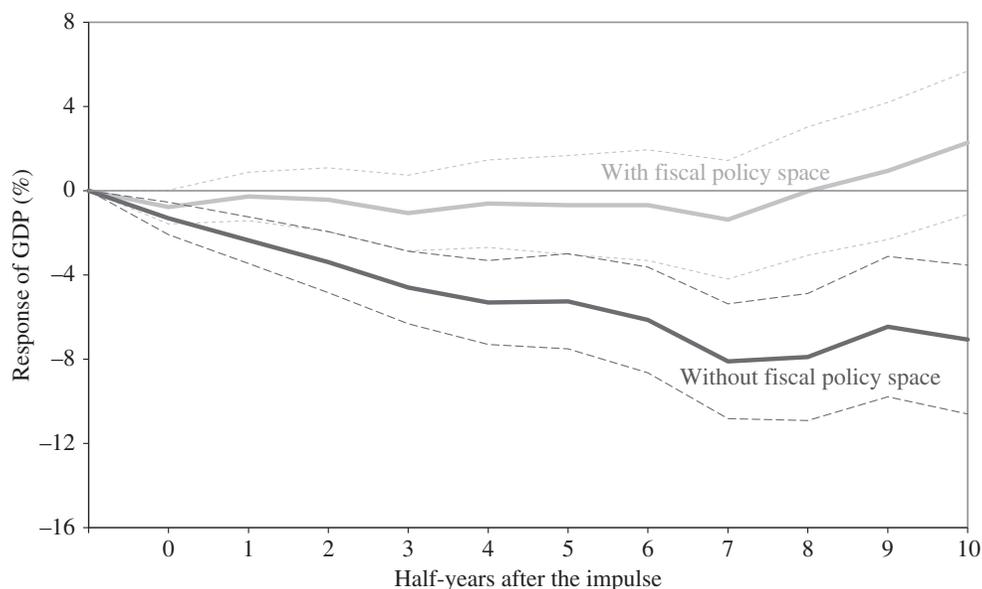
FIGURE 6. Behaviour of real GDP after a financial crisis, with and without fiscal policy space.
Notes: The figure shows the impulse response function for real GDP to an impulse of 7 in our new measure of financial distress derived from estimating equation (2) for the sample of 24 OECD countries over the post-1980 period using OLS. The measure of fiscal policy space used is the (negative) gross debt-to-GDP ratio in the previous calendar year. The 'without fiscal policy space' line corresponds to a value of the debt-to-GDP ratio one standard deviation above the sample average; the 'with fiscal policy space' line corresponds to a value of the debt-to-GDP ratio one standard deviation below the sample average. The dashed lines show the two-standard-error confidence bands.

'with fiscal policy space' as corresponding to a value of the debt-to-GDP ratio one standard deviation below the sample average. The mean level of the gross debt-to-GDP ratio in our sample is 61.4%, and the standard deviation is 34.9%. Thus the results for without fiscal space are for a debt-to-GDP ratio of roughly 96%, and those for with space are for a debt ratio of about 27%.[15]

Figure 6 shows that the aftermath of a financial crisis when a country has fiscal policy space is remarkably mild indeed. The fall in GDP with fiscal space is just 1.4%. The fall in GDP following a crisis without fiscal space reaches a maximum of 8.1%. At nearly all horizons, the two-standard-error confidence intervals for the two responses do not overlap.

A case that exemplifies the importance of the fiscal policy space interaction effect is Italy following the 2008 crisis. Italy began the crisis with a gross debt-to-GDP ratio of almost exactly 100%—just slightly more than one standard deviation above the average for our sample. So its fiscal space was quite limited. We again construct two forecast errors for this episode: one is based on our parameter estimates from equation (2) and so includes the interaction effect, and the other is from a specification that excludes the interaction terms.

The results are shown in Figure 7. As in Figure 3, the simple forecast errors are large and negative after the 2008 crisis. But when we account for Italy's lack of fiscal space, the forecast errors are roughly zero. Virtually all of Italy's large negative forecast errors in this episode vanish when we take into account the fact that Italy had little fiscal space, and low fiscal space is typically associated with worse outcomes following a crisis.
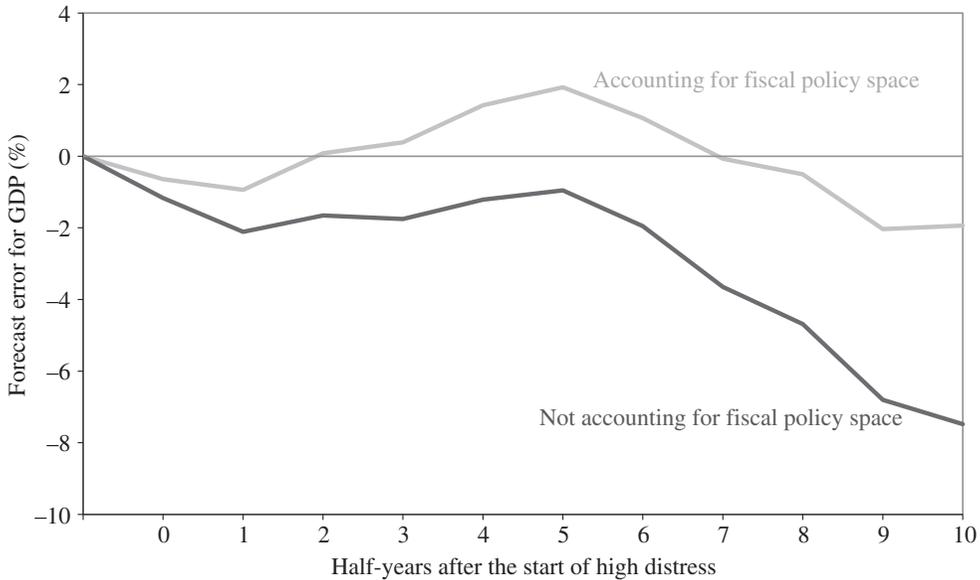
FIGURE 7. GDP forecast errors for Italy following the 2008:2 crisis, accounting and not accounting for fiscal policy space.
Notes: The figure shows the forecast errors for real GDP (defined as actual minus forecast) following the financial crisis in Italy. In this episode, financial distress first reached 7 or above in 2008:2. The measure of fiscal space used is the (negative) gross debt-to-GDP ratio in the previous calendar year. The forecast accounting for fiscal policy space is derived by estimating equation (2) over the full sample, and then using actual GDP data up to one half-year before distress reached 7, and the measure of fiscal policy space, the interaction term, and actual distress up to when distress reached 7. The forecast not accounting for fiscal policy space is derived in the same way, except that the interaction term (both the contemporaneous value and lags) between fiscal policy space and financial distress is omitted from both the equation that is estimated and the construction of the forecast.

Robustness These results for the importance of fiscal space are highly robust. For example, using the net debt-to-GDP ratio (multiplied by -1) instead of the gross debt ratio, the estimated coefficients on the interaction term are positive and highly significant at all horizons. A lower debt ratio (which corresponds to more fiscal space) is associated with a milder aftermath. In this case, the fall in GDP following a crisis without fiscal space reaches a maximum of 8.8%. The fall in GDP following a crisis when there is fiscal space is 1.6%.[16]

Similarly, when we replace the simple gross debt-to-GDP ratio with the non-linear function described above, the maximum decline in GDP without fiscal space is 8.8%, and 0.8% with.[17] The estimated coefficient on the interaction term is again consistently positive, and the *t*-statistic is over 3 for horizons 2 to 10.

Another alternative specification of fiscal policy space includes both the (negative) gross debt-to-GDP ratio and a dummy variable equal to 1 if the country is not subject to the European Union's SGP. In this specification, we include not only the two interaction terms, but also the level of both measures of fiscal space and the relevant lag terms. The estimated coefficients on the interaction term for the not-SGP variable suggest that the output decline following an impulse of 7 to distress when a country is not subject to the SGP is about 1 to 2.5 percentage points smaller at most horizons than when it is subject to the SGP. At the same time, the effect is not statistically significant at any horizon.

Importantly, including this auxiliary indicator of fiscal policy space has little impact on either the magnitude or the statistical significance of the estimated interaction effect involving our primary measure of fiscal space (the negative of the gross debt-to-GDP ratio).

Finally, returning to just our primary measure of fiscal policy space, we also experiment with excluding certain countries from the sample. For example, it is natural to worry that Greece plays an outsized role in the estimates. Greece began its 2009 crisis with a very high debt-to-GDP ratio and has done abysmally. But while the difference in aftermaths with and without fiscal space is less dramatic when Greece is excluded, it is still large. The fall in GDP following a crisis in cases without fiscal space reaches a maximum of 5.7%; the fall in GDP in cases with fiscal space is 2.8%. The estimated coefficient on the interaction term, however, is significant only for short horizons.

Combining both types of policy space

The obvious extension to consider is to include interactions with both types of macropolicy space.

Specification and results In this case, we expand equation (2) to include two interaction terms. That is, we regress output at various horizons on financial distress at time t, including interactions both between distress and monetary policy space and between distress and fiscal policy space. We also include the level of both types of policy space. We focus on our two baseline measures of policy space: the dummy variable for whether the policy interest rate is above 1.25% and the (negative) gross debt-to-GDP ratio.

The results on the importance of policy space are slightly stronger for the two types of policy together than for each separately. Figure 8 summarizes the results. The figure shows the response of output to a moderate financial crisis (an impulse of 7 in our new measure of financial distress) for two cases—with both types of policy space and without either type.[18] The striking finding is just how small the negative aftermath of a financial crisis is when a country has both types of policy space. The fall in GDP after a crisis is less than 1% and not significantly different from zero. It also goes away completely after 3½ years. On the other hand, being without either type of space is associated with a large and significantly negative aftermath. The fall in GDP following a crisis when there is not policy space is almost 10%. The confidence intervals for the two responses do not overlap at any horizon after horizon 0.

In the specification with these two measures of policy space, the estimated coefficients on both interaction terms are positive and substantial. Their relative sizes indicate that at most horizons, about two-thirds of the overall difference between the output decline with and without policy space shown in Figure 8 is due to fiscal policy space, and one-third to monetary policy space. In addition, the estimated coefficients on the interaction term for monetary policy space are only marginally significant, while those for fiscal policy space are strongly so. This could indicate that fiscal policy space is somewhat more important.

Robustness This last finding is not particularly robust. For some measures of space and samples of countries, the estimated interaction effects for monetary policy space appear more important than those for fiscal policy space. For example, for the baseline measures of space in the sample excluding Greece, the interaction of financial distress and monetary policy space enters more strongly and significantly than the interaction with fiscal policy space. At the other extreme, in some specifications (such as that including the
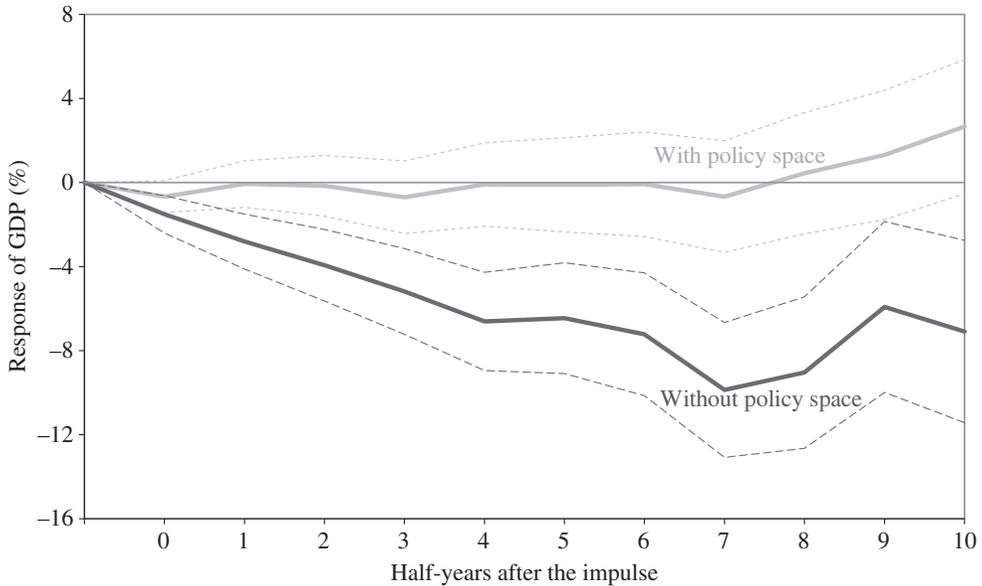
FIGURE 8. Behaviour of real GDP after a financial crisis, with *both* monetary and fiscal policy space and without *either* monetary or fiscal policy space.
Notes: The figure shows the impulse response function for real GDP to an impulse of 7 in our new measure of financial distress derived from estimating an expanded version of equation (2) for the sample of 24 OECD countries over the post-1980 period using OLS. The specification includes interaction and level effects of both monetary policy space and fiscal policy space (along with the relevant lags). The measure of monetary policy space used is a dummy variable equal to 1 if the policy interest rate is greater than 1.25% at the end of the previous half-year. The measure of fiscal policy space used is the (negative) gross debt-to-GDP ratio in the previous calendar year. The 'without policy space' line corresponds to a value of the monetary policy space dummy of 0 and a value of the debt-to-GDP ratio one standard deviation above the sample average; the 'with policy space' line corresponds to a value of the monetary policy dummy of 1 and a value of the debt-to-GDP ratio one standard deviation below the sample average. The dashed lines show the two-standard-error confidence bands.

more complicated treatment of the euro area) the estimated coefficient on the monetary policy space interaction term is insignificant, and that on the fiscal policy space interaction term is even larger and more significant.

What is robust is that when interactions with both types of space are included, the aftermath of a crisis is much worse without space than with. This is true across all combinations of measures of monetary and fiscal policy space, and when various potentially unusual countries are excluded.

Forecasting exercise To get a sense of how much of the variation in the aftermaths of financial crises can be accounted for by the interactions with policy space, we do a forecasting exercise similar to those shown for individual countries in Figures 5 and 7. However, in this case, we analyse the forecast errors for output following all nineteen episodes when distress reached 7, and compare the forecasts excluding the interaction terms with ones that include the interactions of distress and the baseline measures of both monetary and fiscal policy space. In both the simple forecast and the forecast taking into account the interactions, we include the level of the two policy space variables. In forming the forecasts, we use actual output data up to one half-year before distress

reached 7, and financial distress, policy space and the interaction terms up to the half-year when distress reached that benchmark.

A way of summarizing the results is to compare the variance of the forecast errors at different horizons from the specifications without and with the policy interaction terms for all nineteen episodes together. In the half-year when distress first reached 7, the variances of the forecast errors are roughly equal. After that, including the interaction terms reduces the variance of the forecast errors substantially. After 1½ years, the variance of the forecast errors including the policy space interaction terms is about 20% smaller than that of the forecast errors without the interaction terms; after 5 years, it is 30% smaller.[19] This finding suggests that differences in policy space across countries and episodes explain a substantial fraction of the observed variation in the aftermaths of crises.

III. MECHANISMS BY WHICH MACROPOLICY SPACE MATTERS

Having found that macropolicy space is important, the obvious next question is why. What are the mechanisms by which policy space makes the decline in output following a financial crisis smaller? The most obvious possibility is that policymakers use policy more aggressively to respond to crises and the recessions that follow when they have policy space. Another possibility is that financial distress itself is less persistent when there is policy space.

To see if policymakers use policy more aggressively when there is policy space, we run panel regressions similar to those in Section II. But in place of output on the left-hand side, we use an indicator of policy as the dependent variable. We run the regressions separately for monetary and fiscal policy, and assume that monetary policy space is the relevant interaction for the monetary policy response, and fiscal policy space is the relevant interaction for the fiscal policy response. Similarly, to test whether financial distress is less persistent when there is policy space, we run a final set of panel regressions. We put distress on the left-hand side and estimate how the response of distress to itself varies with policy space.

The monetary policy response

First, we consider the response of monetary policy to financial distress when countries do and do not have monetary policy space.

Data and specification Our focal measure of monetary policy is the change in the policy interest rate. Our question is whether the change in the policy rate following financial distress is greater if the country has monetary policy space. The particular specification that we estimate is

$$
\begin{aligned}
r_{j,t+i} - r_{j,t-1} = &\; \alpha_j^i + \gamma_t^i + \zeta^i S_{j,t} + \beta^i F_{j,t} + \delta^i (F_{j,t} \cdot S_{j,t}) \\
&+ \sum_{k=1}^{4} \rho_k^i S_{j,t-k} + \sum_{k=1}^{4} \varphi_k^i F_{j,t-k} + \sum_{k=1}^{4} \omega_k^i (F_{j,t-k} \cdot S_{j,t-k}) \\
&+ \sum_{k=1}^{4} \theta_k^i \Delta r_{j,t-k} + e_{j,t}^i,
\end{aligned}
$$

(3)

where $r_{j,t+i}$ is the nominal policy interest rate for country j at time $t + i$. $F_{j,t}$ is again financial distress in country j at time t, $S_{j,t}$ is a measure of monetary policy space for country j at time t, and the α and γ terms are country and time fixed effects, respectively. Thus we regress the change in the policy rate from $t - 1$ to $t + i$ on financial distress at time t and the interaction between distress and monetary policy space (also at t). We estimate equation (3) for horizons 0 to 10. Because the dependent variable is the change in the policy rate from $t - 1$ to $t + i$, the estimated β^i and δ^i terms for the successive horizons show effects on the cumulative change in the policy rate.

As an alternative measure of monetary policy, we use the level of the policy rate (as opposed to the change). For this specification, the dependent variable is just $r_{j,t+i}$, and the appropriate control variables on the right-hand side are the lagged levels of the policy rate rather than the lagged changes. In this specification, the lagged values of the policy rate capture longer-run patterns of mean reversion (such as the fact that deliberate monetary contractions to reduce inflation eventually end). This is a disadvantage to the extent that the mean reversion in policy rates is different following financial crises than in more normal periods. In contrast, in the baseline specification, the lagged values of the change in the policy rate capture only relatively high-frequency mean reversion.

In our baseline estimates, we use as our measure of monetary policy space the simple dummy variable for whether the policy interest rate was above 1.25% at the end of the previous half-year. We also consider other measures, such as the dummy variable that also codes participation in the euro area as being without monetary policy space.

Countries often raise policy rates somewhat in the run-up to severe financial distress to try to defend the exchange rate or to attempt to cool off asset price bubbles. However, the case of Turkey in 2000 is particularly extreme. Turkey raised its policy rate to such heights that it was able to cut its policy interest rate by 120 percentage points when the financial crisis hit. Such an extreme move will likely drive any estimate of the response of policy rates to financial distress. For this reason, we think the most informative sample excludes Turkey. However, we also report the results for the full sample.

Results When we estimate equation (3) using our baseline measure of monetary policy space and the sample that excludes Turkey, the estimated coefficient on the interaction term is negative as expected, highly significant at horizons 1 to 5, and solidly significant at longer horizons. Figure 9 shows the response of the policy interest rate to a realization of the financial distress variable of 7 when a country does and does not have monetary policy space. When a country does have monetary space, the policy rate falls 1.9 percentage points (and much of that decline happens very quickly). When it does not have space, the policy rate actually rises slightly, though the rise is not statistically significant.

If one looks at what happened to the policy interest rate in episodes of acute financial distress, the difference is more pronounced. In virtually all of those, it looks as if monetary policy responds strongly to financial crises if the country has space, and essentially not at all when it does not.

Panel A of Figure 10 shows two cases where policymakers began a crisis with ample monetary policy space. One is the USA in 1990, when there was substantial financial distress related to the savings and loan crisis and other problems in the banking sector. The other is Finland in 1993. To aid in the interpretation, we show the measure of financial distress as well as the policy interest rate. The figure shows that the policy interest rate dropped dramatically in both cases.
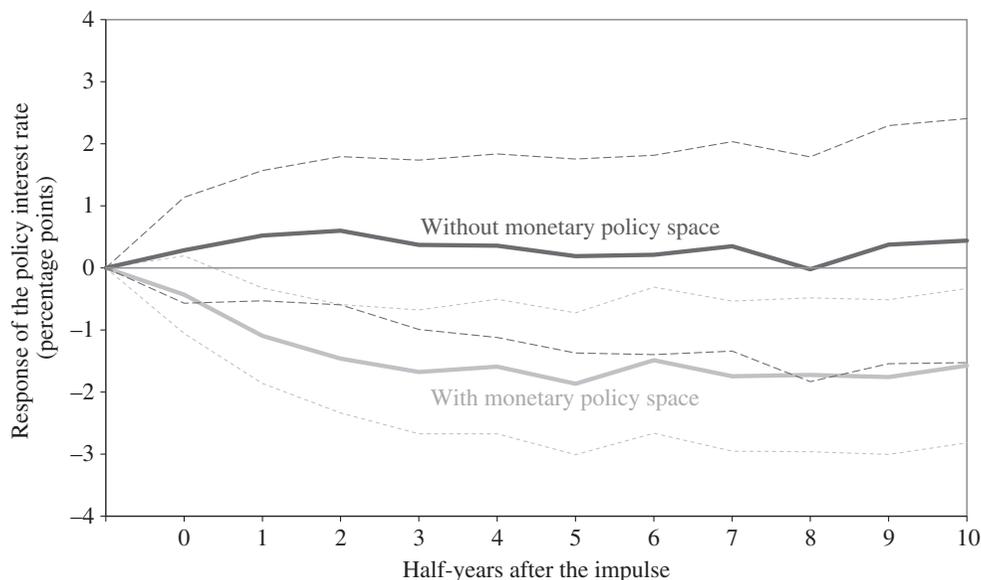
FIGURE 9. Behaviour of the policy interest rate after a financial crisis, with and without monetary policy space.

Notes: The figure shows the impulse response function for the policy interest rate to an impulse of 7 in our new measure of financial distress derived from estimating equation (3) for the sample of 24 OECD countries over the post-1980 period using OLS. The measure of monetary policy space used is a dummy variable equal to 1 if the policy interest rate is greater than 1.25% at the end of the previous half-year. The 'without monetary policy space' line corresponds to a value of the dummy of 0; the 'with monetary policy space' line corresponds to a value of the dummy of 1. The dashed lines show the two-standard-error confidence bands.

Panel B of Figure 10 shows two cases where monetary policy space was limited at least partway through the period of high financial distress. One is Japan following its acute distress in 1997. Notice that the policy rate could not fall at all despite very severe distress. The other is Portugal after the 2008 crisis. Portugal and the other countries of southern Europe suffered significant financial distress after the ECB had already hit the zero lower bound. As a result, the policy rate had nowhere further to fall, even though distress remained very high.

Robustness The results are similar to those in the baseline when other measures of monetary policy space are used. For example, when a dummy variable equal to 1 if the policy rate is above 1.25% and the country is not in the euro area is used as the measure of monetary policy space, the estimated coefficient on the interaction term is again highly significant at all horizons after horizon 0. The response of the policy rate following a crisis is a maximum decline of 2.1 percentage points when there is policy space, and a small and insignificant rise when there is not.

On the other hand, returning to the simple dummy as the measure of monetary policy space, but using the level of the policy rate rather than the change as the measure of monetary policy, weakens the results substantially. The estimated coefficient on the interaction between financial distress and monetary policy space is generally negative, but never statistically significant. At short horizons, the decline in the policy rate in response to an impulse of 7 in financial distress is about a percentage point greater when

Panel A. When there was monetary policy space

Panel B. When there was *not* monetary policy space

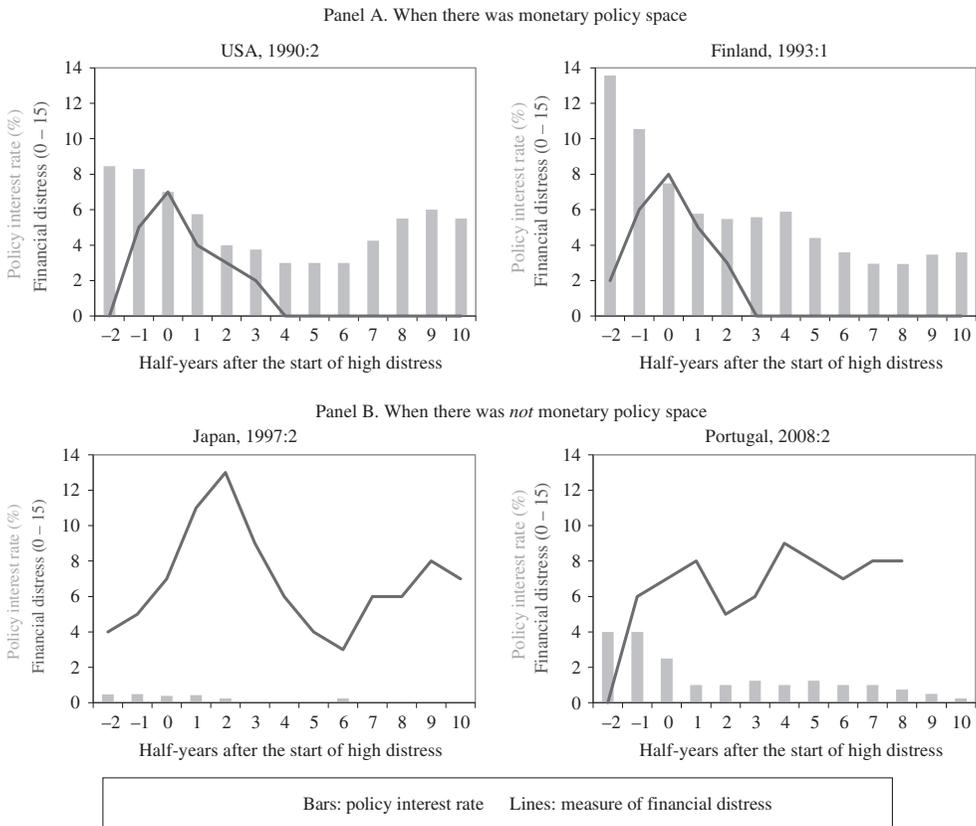Bars: policy interest rate   Lines: measure of financial distress

FIGURE 10. Behaviour of the policy interest rate in selected episodes of high financial distress, when there was and was not monetary policy space.

Notes: The panels show the measure of financial distress and the policy interest rate in four episodes of high distress. Each date given corresponds to when the financial distress variable first reached 7 or above during the episode. Panel A shows two examples where monetary policy space was substantial throughout the period of high distress; panel B shows two examples where monetary policy space was limited during at least part of the period of high distress. See the text and the Data Appendix for a description of data sources and transformations.

there is space than when there is not. However, at longer horizons the difference is trivial. The source of the similarity between the two responses appears to be that in this specification, much of the decline in the policy rate during crises when there is policy space is attributed to normal longer-run mean reversion or soaked up by the time fixed effects. As discussed above, however, the forces driving mean reversion in normal times are unlikely to be very relevant to the monetary policy response to financial distress.

Our baseline sample for this analysis excludes Turkey. Not surprisingly, including Turkey in the sample strengthens the results dramatically. The estimated coefficient on the monetary policy space interaction term is strongly negative, with a *t*-statistic over 3 at all horizons after horizon 0. The maximum decline in the policy interest rate in response to an impulse to financial distress of 7 is 0.5 percentage points where there is not monetary policy space, and 9.5 percentage points when there is.

The fiscal policy response

Now consider the response of fiscal policy to financial distress when countries do and do not have fiscal space.

Data and specification Fiscal policy data are again a challenge. As described in the Data Appendix, annual data on the actual budget surplus are available from the IMF and the OECD for most countries back to 1980. But for advanced countries, where tax revenues and some types of government spending fluctuate strongly with economic activity, the change in the actual surplus can be a very misleading measure of fiscal policy. Unfortunately, official estimates of the high-employment surplus (that is, the actual budget surplus net of automatic stabilizers) are typically not available before 2000.

As a crude proxy for the change in the high-employment surplus as a share of GDP, we start with the change in the actual surplus as a share of GDP over some horizon, and then subtract the product of an estimate of the sensitivity of the fiscal balance to the output gap and the change in the logarithm of real GDP over the same horizon. What this procedure does is to take out any change in the surplus coming just from the effect of faster or slower than normal growth on tax revenues and government spending. We use as our estimate of the relevant sensitivity 0.4, which is a lower-bound estimate of the responsiveness of the fiscal balance to the output gap for our sample of OECD countries.[20]

We then regress our proxy for the change in the high-employment surplus as a share of GDP over various horizons after time t on financial distress and the interaction between distress and fiscal policy space, both at time t. The specific equation that we estimate is

$$
(B_{j,t+i} - B_{j,t-1}) - \tau \cdot (y_{j,t+i} - y_{j,t-1}) = \alpha_j^i + \gamma_t^i + \zeta^i S_{j,t} + \beta^i F_{j,t} + \delta^i (F_{j,t} \cdot S_{j,t})
$$

(4)
$$
+ \sum_{k=1}^{4} \rho_k^i S_{j,t-k} + \sum_{k=1}^{4} \varphi_k^i F_{j,t-k} + \sum_{k=1}^{4} \omega_k^i (F_{j,t-k} \cdot S_{j,t-k})
$$

$$
+ \sum_{k=1}^{4} \theta_k^i \left(\Delta B_{j,t-k} - \tau \cdot \Delta y_{j,t-k} \right) + e_{j,t}^i,
$$

where $B_{j,t+i}$ is the actual budget surplus in country j in $t + i$, τ is the assumed sensitivity of the surplus to the output gap, and $S_{j,t}$ is a measure of fiscal policy space for country j at time t. The rest of the notation is as before. We include as controls lags of our proxy for the change in the high-employment surplus (the $\Delta B_{j,t-k} - \tau \cdot \Delta y_{j,t-k}$ terms).[21] We estimate the regression over horizons 0 to 10 using the full sample of countries. As with the change in the policy interest rate, because the dependent variable is the change in the high-employment surplus from $t - 1$ to $t + i$, the estimated β^i and δ^i terms for the successive horizons show effects on the cumulative change in the high-employment surplus.

Given that our approach to estimating the high-employment surplus is inherently imperfect, we also consider a specification that uses just the level of the actual budget surplus (as a share of GDP) as the dependent variable. In this case, we include lags of the actual surplus as control variables.

In our baseline estimates, we use the negative ratio of gross debt to GDP as our measure of fiscal policy space. As robustness checks, we consider the various alternatives

described in Section II. For example, we also use the more complicated specification of fiscal space that includes both the negative of the gross debt ratio and a dummy variable for whether a country is not subject to the European Union's Stability and Growth Pact.

One complication in the analysis of the fiscal policy response is that the surplus data are available only annually. To maintain the parallel with the monetary policy regressions, we convert the surplus data to semi-annual by simply repeating the annual observation for both observations in a year. As an alternative, we also run the regressions using annual observations for all variables.[22] In the annual specification, we include two lags of all variables as controls. The measure of fiscal space is the (negative) gross debt-to-GDP ratio in the previous year.

Results The results are remarkably clear-cut. When we use our baseline specification and measure of fiscal policy space, the estimated interaction effect is consistently negative— indicating that the high-employment surplus falls more following distress when there is fiscal space. The interaction effect is also highly statistically significant: the *t*-statistic is above 3.5 at eight horizons, and always above 2.5.

Figure 11 summarizes the results by showing the cumulative change in the high-employment surplus (as a share of GDP) following a realization of distress of 7 in countries with and without fiscal space. Countries with space (which, for the purpose of the figure, we again define as having a gross debt-to-GDP ratio one standard deviation below the mean) cut their high-employment surplus as a share of GDP by a maximum of 3.5 percentage points in response to a financial crisis. That is, they engage in substantial fiscal expansion. Countries without space (which we again define as having a gross debt-to-GDP ratio one standard deviation above the mean) actually raise their high-employment surplus (as a share of GDP) by even more. The maximum rise is 4.1 percentage points. That is, they have substantial fiscal contraction.

Given the history of countries with high debt facing financial crises, this finding is not as surprising as it might seem. Countries with high debt are often forced into fiscal consolidations after a financial crisis because deteriorating conditions swell their actual deficits, and investor nervousness makes it hard for them to borrow. This difference in fiscal policy could clearly go a long way towards explaining why countries without fiscal space have so much worse outcomes than countries with space.

If one looks at what happened to the high-employment surplus in key episodes, then the relationship between the fiscal policy response and fiscal space is obvious. Panel A of Figure 12 shows what happened to our estimate of the high-employment surplus in two cases with fiscal space.[23] Again, we also show our measure of financial distress. One case is Norway following its severe financial distress in 1991; the other is the UK after the 2008 crisis. Each country began its crisis with a gross debt-to-GDP ratio substantially below the OECD average. And each country had substantial declines in the high-employment surplus as a share of GDP.

Panel B of Figure 12 shows what happened to fiscal policy in two cases where the country experienced financial distress starting with little fiscal space: Japan in 1997 and Italy in 2008. Each country began its crisis episode with a gross debt-to-GDP ratio very close to 100%. In both cases, the high-employment surplus rose following distress.

Not surprisingly, the most extreme example of this pattern is Greece in recent years. Greece began its extreme financial distress in 2009 with a gross debt-to-GDP ratio of 109%. Greece's high-employment surplus as a share of GDP fell somewhat over the first year, but then swung strongly positive. Our estimate of the rise in its high-employment surplus surpassed 15% of GDP after three years.[24] This extreme move to fiscal
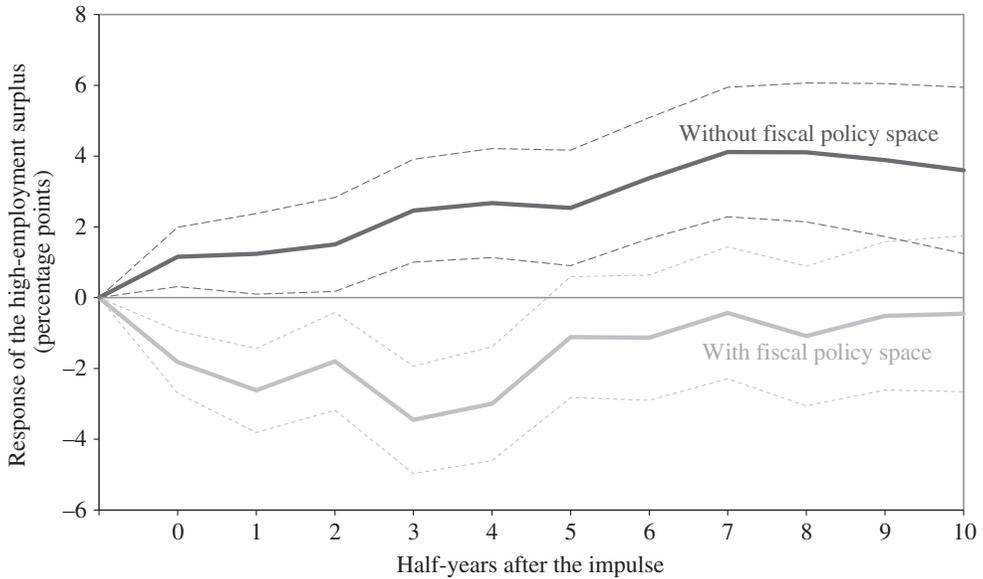
FIGURE 11. Behaviour of the high-employment surplus after a financial crisis, with and without fiscal policy space.

Notes: The figure shows the impulse response function for an estimate of the cumulative change in the high-employment surplus to an impulse of 7 in our new measure of financial distress derived from estimating equation (4) for the sample of 24 OECD countries over the post-1980 period using OLS. The measure of fiscal policy space used is the (negative) gross debt-to-GDP ratio in the previous calendar year. The 'without fiscal policy space' line corresponds to a value of the debt-to-GDP ratio one standard deviation above the sample average; the 'with fiscal policy space' line corresponds to a value of the debt-to-GDP ratio one standard deviation below the sample average. The dashed lines show the two-standard-error confidence bands.

contraction was obviously not a choice, but rather a condition for the coordinated IMF and euro area bailout.

Robustness The finding that fiscal policy is used much more aggressively in response to financial distress when there is fiscal policy space is very robust. For example, when we use the level of the actual surplus in place of our rough measure of the change in the high-employment surplus, the estimated interaction effect is still negative and highly significant at horizons up to two years after financial distress. The maximum decline in the surplus (as a share of GDP) when there is space is 4.0 percentage points. When there is not space, the actual surplus rises by a maximum of 0.9 percentage points.[25] That the difference between the two responses is smaller when the actual surplus is used is hardly surprising. The actual surplus naturally tends to fall after financial distress because output falls; because the output declines are larger in countries with less fiscal space, this effect is larger in those countries. What is perhaps more surprising is that the fiscal space interaction effect is so strongly negative that for countries without fiscal space, even the actual surplus rises following a crisis.

Returning to the change in the high-employment surplus as the measure of fiscal policy, using broader measures of fiscal space yields very similar results to the baseline. One interesting case measures fiscal space using both the continuous gross debt-to-GDP ratio (multiplied by −1) and a dummy variable equal to 1 if a country is not subject to
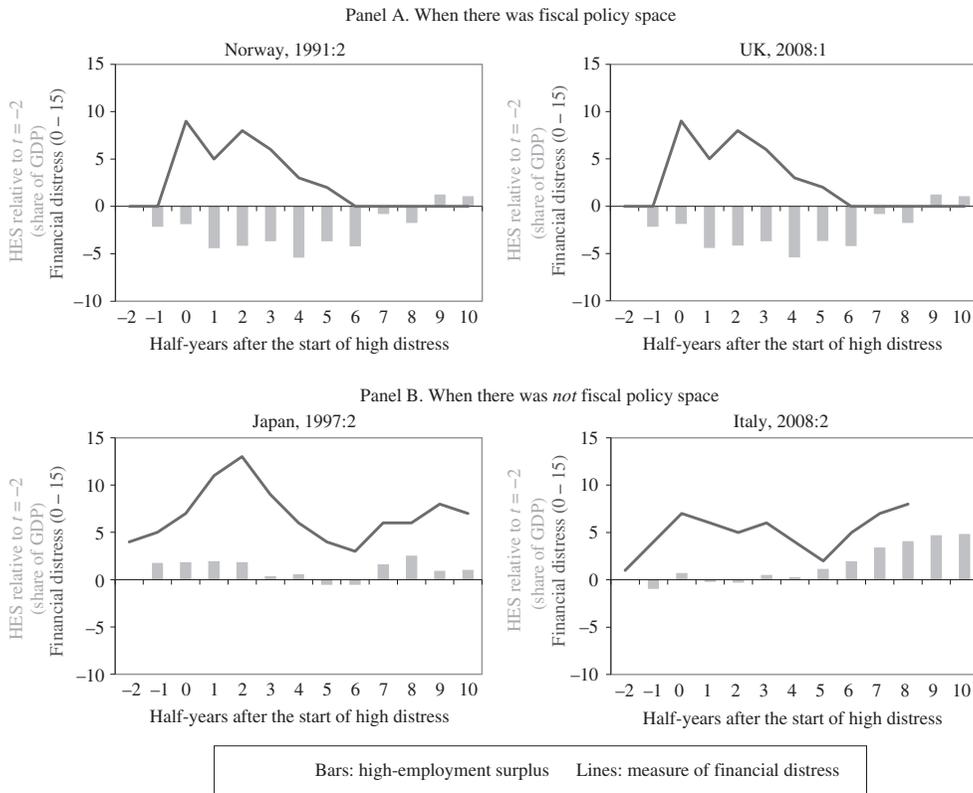
FIGURE 12. Behaviour of the high-employment surplus in selected episodes of high financial distress, when there was and was not fiscal policy space.
Notes: The panels show the measure of financial distress and the high-employment surplus in four episodes of high distress. Each date given corresponds to when the financial distress variable first reached 7 or above during the episode. The number reported for the high-employment surplus is its level relative to two half-years before distress reached 7. Panel A shows two examples where fiscal policy space was substantial throughout the period of high distress; panel B shows two examples where fiscal policy space was limited during at least part of the period of high distress. See the text and the Data Appendix for a description of data sources and transformations.

the European Union's SGP. Because the SGP puts nominal limits on deficits, it is possible that this has a direct bearing on the ability of EU countries to use fiscal policy to respond to crises. In this specification, both estimated interaction effects are negative, implying that in each case more space is associated with larger cuts in the high-employment surplus. The negative interaction effect for the debt ratio continues to be highly significant at all horizons, with a *t*-statistic over 5 at a number of horizons. The negative interaction effect for not being subject to the SGP is generally not statistically significant at short horizons, but is strongly significant at horizons of two years or more. This could suggest that the pact has some effect on the ability of member countries to respond aggressively to financial crises with fiscal stimulus.[26]

Estimating equation (4) using annual data and two lags of all the control variables, if anything, strengthens the results.[27] The estimated interaction effect is again negative—implying that the high-employment surplus falls more when there is more fiscal space—and highly significant. The maximum fall in the annual high-employment surplus is 4.9

percentage points when there is fiscal space. When there is not fiscal space, the annual high-employment surplus *rises* by a maximum of 4.1 percentage points.

Finally, the behaviour of fiscal policy in Greece following its 2009 crisis was so extreme that it is natural to worry that it might be driving the regression results. For this reason, we consider the sample that excludes Greece. In this case, the estimated coefficient on the interaction term is still negative and highly significant at horizons up to four half-years. When the impulse response function is evaluated at a debt-to-GDP ratio one standard deviation below the mean and one standard deviation above the mean, the difference between the two is smaller than when the full sample of countries is used, but still large in an absolute sense. The maximum decline in the high-employment surplus when there is fiscal space in the sample excluding Greece is 3.0 percentage points. When there is not fiscal space, the maximum rise in the high-employment surplus is 2.1 percentage points.

The persistence of financial distress

Taken together, the results for monetary and fiscal policy strongly suggest that a key mechanism by which policy space influences the aftermath of crises is through the policy response. A possibly related mechanism has to do with the nature of the financial distress itself. In Romer and Romer (2017), we show that one can explain much of the variation in the aftermaths of crises with the severity and persistence of distress. That is, outcomes are worse when distress is worse or more long-lasting. But in some sense, that finding just pushes the mystery back a step. Why are some cases of financial distress worse and more long-lasting than others?

Policy space could play a role. It could be that policy space allows for policy that stabilizes output, and restoring growth helps heal the financial system. A more direct role could be that fiscal policy space allows countries to bail out their financial systems, and so reduce distress; or, monetary policy space allows the central bank to flood the financial system with liquidity more easily, and so lower distress that way. Finally, perhaps the very existence of policy space is good for confidence. Distress may not grow or persist because people know that the government can intervene if necessary.

Specification To look at this linkage, we regress financial distress at various horizons after time t on distress at t, including an interaction term with policy space. As before, we also include the level of policy space. That is, we estimate

$$
\begin{aligned}
F_{j,t+i} = {} & \alpha_j^i + \gamma_t^i + \zeta^i S_{j,t} + \beta^i F_{j,t} + \delta^i (F_{j,t} \cdot S_{j,t}) \\
& + \sum_{k=1}^{4} \rho_k^i S_{j,t-k} + \sum_{k=1}^{4} \varphi_k^i F_{j,t-k} + \sum_{k=1}^{4} \omega_k^i (F_{j,t-k} \cdot S_{j,t-k}) + e_{j,t}^i,
\end{aligned}
\tag{5}
$$

where $F_{j,t+i}$ is financial distress in country j at time $t + i$, and $S_{j,t}$ is a measure of policy space. In our baseline specification, we include separate interaction terms between distress and monetary policy space, and between distress and fiscal policy space. In this specification, we include the levels of both space variables (as well as all the relevant lags as control variables). We estimate equation (5) over horizons 1 to 10 for the full sample of countries. The response of financial distress to itself with and without policy space can show whether the existence of policy space makes distress less persistent.

We again use as our baseline measure of monetary policy space the dummy variable equal to 1 if the policy rate at the end of the previous half-year was greater than 1.25%. Our baseline measure of fiscal policy space is the (negative) gross debt-to-GDP ratio. We test the robustness of the results to different measures of policy space and to samples that exclude potential outliers.

Results We find strong evidence that financial distress is less persistent when there is policy space. The estimated coefficients on the interaction terms with both types of space are generally negative—indicating that distress dies out more quickly when there is space. For both monetary and fiscal policy space, the coefficients on the interaction terms range from insignificant to solidly significant. To the degree that there is a difference in the estimated interaction effects, the monetary policy space interaction appears to be more important at short horizons (but actually turns positive at longer horizons), while the fiscal policy interaction appears to be stronger (and remains negative) at longer horizons.

To give a sense of magnitudes, Figure 13 shows the response of financial distress to a substantial innovation in distress (a 7 on our scale) with and without policy space.[28] An innovation in financial distress dies off much more quickly when there is policy space. Without either monetary or fiscal space, after 2½ years the initial 7 has fallen to only 4.4; with both types of policy space, it has fallen to 1.8. The initial impulse is completely gone after three years when there is policy space, but some distress remains even after five years when there is not.

If one looks at the behaviour of financial distress in key episodes, there is a clear relationship between the persistence of distress and policy space. Panel A of Figure 14 shows financial distress in two cases where the country had both monetary and fiscal policy space: Sweden in 1993 and Iceland in 2008. Each country entered its episode of financial distress with a policy interest rate well above the zero lower bound and a gross debt-to-GDP ratio substantially below the OECD average. In Sweden, the distress was resolved almost immediately; in Iceland, it spiked to a very high level but then dissipated fairly rapidly and completely. Panel B shows financial distress in two cases where the country experienced high distress starting with little monetary or fiscal space: Japan in 1997 and Italy in 2008. Each country began its crisis episode with a very low policy rate and a gross debt-to-GDP ratio close to 100%. In both cases, financial distress remained high for years.

Robustness Surprisingly, the results are quite similar to those in the baseline if we estimate equation (5) including only the interaction between distress and monetary policy space or that between distress and fiscal policy space. The estimated interaction effects when the two policy space interactions are entered individually are somewhat larger and more precisely estimated than when the two are entered jointly. As a result, in either of these two alternative specifications, the impulse response functions with and without policy space are quite similar to those in the baseline. For example, in the specification with only the interaction with monetary policy space, an impulse to financial distress of 7 falls to 4.9 after 2½ years when there is not monetary policy space and 2.2 when there is. In the specification with only the interaction with fiscal policy space, the difference is more noticeable at shorter horizons. After two years, an impulse to distress of 7 has fallen to 3.9 when there is not fiscal policy space and 1.7 when there is.

We also consider the effect of using different measures of monetary and fiscal policy space. For example, we estimate equation (5) using as the measure of monetary policy
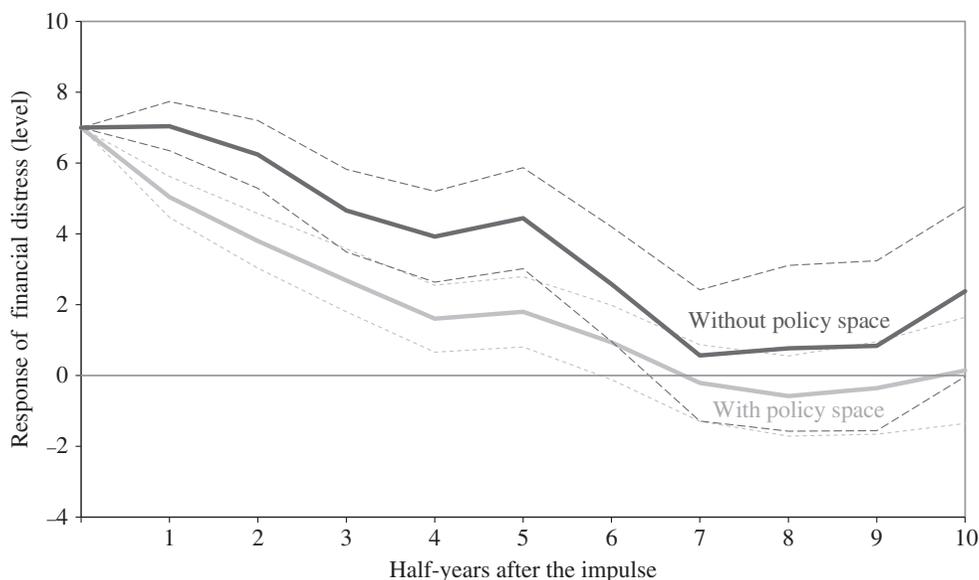
FIGURE 13. Behaviour of financial distress after a financial crisis, with *both* monetary and fiscal policy space and without *either* monetary or fiscal policy space.

Notes: The figure shows the impulse response function for financial distress to an impulse of 7 in itself derived from estimating equation (5) for the sample of 24 OECD countries over the post-1980 period using OLS. The specification includes interaction and level effects of both monetary policy space and fiscal policy space (along with the relevant lags). The measure of monetary policy used is a dummy variable equal to 1 if the policy interest rate is greater than 1.25% at the end of the previous half-year. The measure of fiscal policy space used is the (negative) gross debt-to-GDP ratio in the previous calendar year. The 'without policy space' line corresponds to a value of the monetary policy space dummy of 0 and a value of the debt-to-GDP ratio one standard deviation above the sample average; the 'with policy space' line corresponds to a value of the monetary policy dummy of 1 and a value of the debt-to-GDP ratio one standard deviation below the sample average. The dashed lines show the two-standard-error confidence bands.

space the dummy variable that also takes into account the consequences of being in the euro area, and using as the measure of fiscal policy space both the (negative) gross debt-to-GDP ratio and the dummy variable for not being subject to the SGP. In every case, the estimated coefficients on the interaction terms are generally negative and frequently significant. Distress consistently dies off much more slowly when there is not policy space than when there is.

Finally, the results are also robust to leaving out possible outliers. Japan and Greece faced both prolonged financial distress and severe limitations on monetary and fiscal policy space, so it is possible that they play a large role in the estimates. When we estimate equation (5) using the baseline measures of both monetary and fiscal policy space but leaving out Japan, the results are if anything slightly stronger. The estimated interaction effects for both monetary policy space and fiscal policy space are still predominantly negative and typically significant or nearly so. After 2½ years, an impulse to distress of 7 has fallen to 4.8 when there is not policy space and 1.5 when there is. When we do the same exercise but leave out Greece instead, the results get slightly weaker. In this case, after 2½ years an impulse to distress of 7 has fallen to 3.9 when there is not space and 2.2 when there is.

The bottom line of this analysis is that policy space appears to affect the aftermath of financial crises through various mechanisms. It is correlated with both more aggressive
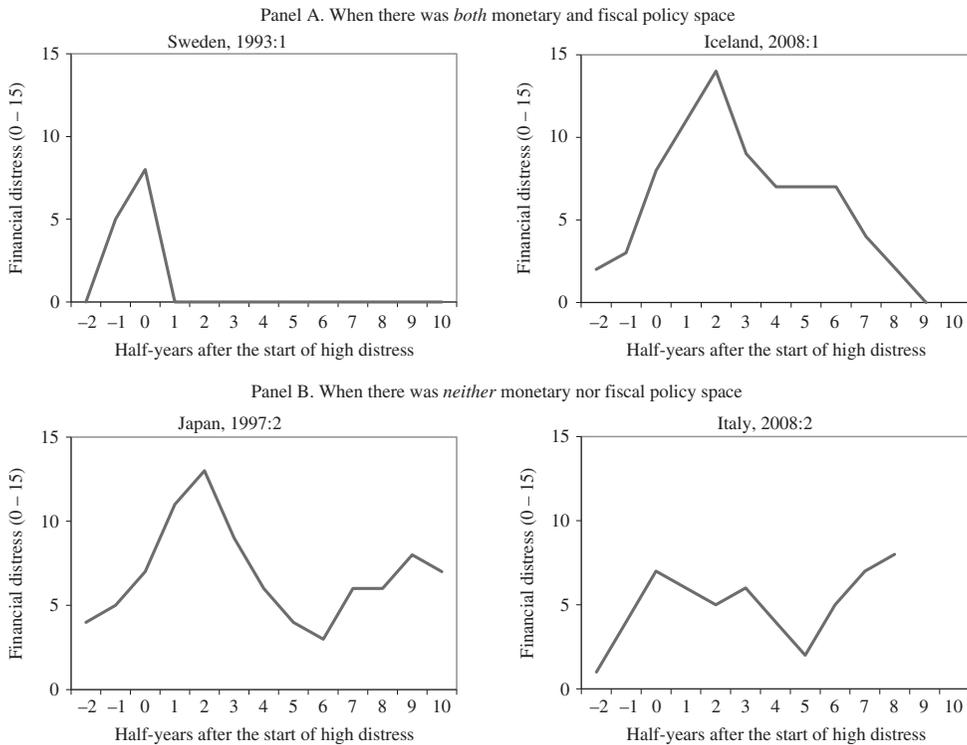
FIGURE 14. Behaviour of financial distress in selected episodes of high financial distress, when there was and was not macropolicy space.

Notes: The panels show the measure of financial distress in four episodes of high distress. Each date given corresponds to when the financial distress variable first reached 7 or above during the episode. Panel A shows two examples where monetary and fiscal policy space were both substantial throughout the period of high distress; panel B shows two examples where both monetary and fiscal policy space were limited during at least part of the period of high distress. See the text for the source of the distress series.

policy responses and less persistent financial distress. Both factors are likely to be associated with less severe post-crisis downturns.

IV. Conclusion

This paper seeks to explain why the aftermath of financial crises varies widely across episodes—even within a quite homogeneous sample of advanced countries in the postwar period. Our evidence shows that macroeconomic policy plays a key role.

Summary

The central finding of the paper is that the aftermath of financial distress is much worse when a country lacks monetary and fiscal policy space than when it has one or both of them. Indeed, the estimates suggest that for a country with both types of policy space, the fall in GDP following a moderate financial crisis is quantitatively small and statistically indistinguishable from zero. These results are robust to the measures of monetary and fiscal space used. Moreover, an examination of the forecast errors for output in the

nineteen episodes of significant distress in our sample shows that policy space accounts for a substantial fraction of the variation in aftermaths that we observe. Some crises appear to be less traumatic than others because policy is much more able to respond.

We also investigate the mechanisms by which policy space matters. We find that countries that experience financial distress with monetary policy space cut their policy interest rate substantially more than those that face distress with the policy rate already very low. Countries that experience distress with a relatively low debt-to-GDP ratio cut their high-employment surplus substantially, while those with a relatively high debt-to-GDP ratio actually run significantly contractionary fiscal policy. We also find that financial distress itself is more persistent in countries without macropolicy space than in countries with space. This could be a manifestation of the inability to use monetary and fiscal policy, or it could be another channel by which a lack of policy space causes the negative aftermaths of crises to be more severe.

Possible policy implications

The finding that having the ability and will to use macroeconomic policy to respond to a crisis explains much of the variation that we observe in the aftermaths of crises is at once both unsurprising and radical. It is unsurprising because a vast number of empirical studies find that both monetary and fiscal policy have important effects on economic activity. Thus it is completely sensible that having more policy space and actually using policy more aggressively is correlated with less severe aftermaths of financial crises.

The finding is nevertheless radical because much of the literature has stressed the inexorable negative effects of financial disruptions. That has led many policymakers to think that the aftermath of crises is out of their hands. Our evidence indicates strongly that this simply is not true. Policymakers can to a large degree control their country's fate.

At the same time, the policy prescriptions suggested by the findings may be hard for policymakers to follow. Our finding that facing a crisis with monetary and fiscal space is associated with better outcomes suggests the need for difficult decisions in non-crisis periods if policymakers want to be able to cushion the effects of future financial crises. If fiscal policymakers want to be in a position to pursue fiscal expansion in response to financial crises and other shocks, then they need to eschew persistent budget deficits and maintain relatively low debt-to-GDP ratios. That is, fiscal policy would need to be highly responsible in good times.

And perhaps counterintuitively, if monetary policymakers want to be able to combat future crises, then they may need to be a little less responsible in normal times. Very low inflation means that nominal interest rates tend to be low, so monetary policy space is inherently limited. A somewhat higher target rate of inflation might actually be the more prudent course of action if policymakers want to be able to reduce interest rates when needed.

Our finding that policy space matters substantially through the degree to which policy is used during crises also implies difficult decisions. For example, it is not enough to have ample fiscal space at the start of a crisis. For the space to be useful in combating the crisis, policymakers have to actually enact aggressive fiscal expansion. However, countercyclical fiscal policy has become so politically controversial that policymakers might refuse to use it the next time a country faces a crisis.

One possible way to respond to these challenges is to focus on policy responses that are less dependent on policy space or less politically controversial. For example, on the

fiscal side, packages that pair short-run increases in the deficit with long-run fiscal consolidations could be less controversial than simple short-run stimulus, and might be available even to countries with limited fiscal space. Similarly, budget actions that pay for an increase in government purchases through increased taxes could provide useful stimulus after a crisis through the balanced-budget multiplier without increasing debt levels. On the monetary side, it is possible that lender of last resort policies, quantitative easing, negative policy interest rates and robust expectations management could provide short-run expansion even when conventional monetary policy space is limited.

Directions for further research

One obvious direction for further research involves the optimal design and effectiveness of such alternative policies. For example, how could intertemporal fiscal packages be designed so that they are likely to be credible and effective? Similarly, is there evidence that balanced-budget multipliers are sufficiently large that a plausible balanced-budget fiscal response to a crisis could have substantial effects? There is also a wide range of research questions surrounding unconventional monetary policy. For example, are there steps to enhance credibility or alternatives to conventional inflation targeting that would make expectations management more effective—and so make it easier for a central bank to use forward guidance or actions aimed at changing inflation expectations to respond to a financial crisis?

Returning to the basic questions of the paper, there are a number of remaining issues. One involves the appropriate measures of monetary and fiscal policy space. For example, we have focused most closely on the debt-to-GDP ratio as our indicator of fiscal space. While pre-crisis debt levels are likely to affect a country's use of fiscal policy to respond to a crisis even if it did not have to pay an interest rate premium before the crisis, sovereign interest rate spreads could provide additional information on borrowing capacity across countries. Likewise, the recent experience of advanced economies may suggest that the true lower bound on interest rates is noticeably below zero.

The treatment of the euro area's common monetary authority and the European Union's fiscal rules also warrant further consideration. For example, given the likelihood of contagion, what is the best way to model how the European Central Bank is likely to respond to a financial crisis in a single euro area country? Similarly, are the fiscal rules encompassed in the Stability and Growth Pact crucial determinants of the fiscal policy response to financial crises in the European Union, or are those responses primarily driven by ideology and other considerations?

A related issue concerns our evidence that macroeconomic policy space appears to influence the aftermath of crises in large part through its impact on the policy response. In the case of fiscal policy, this finding could reflect policymakers' beliefs about appropriate fiscal policy, the impact of fiscal rules, or genuine market constraints on borrowing. To the degree that the link is not inherent or directly causal, it might suggest that fiscal policy could be used more broadly to mitigate the negative aftermath of financial distress. Thus further research on the nature of this linkage between policy space and the policy response would be desirable.

Finally, an important limitation of this study is the difficulty of establishing causation more generally. Our measure of financial distress itself mixes together exogenous variation in financial distress and distress resulting from output declines. Likewise, even *ex ante* policy space could be correlated with other factors affecting output in the wake of financial distress, such as effective government or financial regulation. As a result, our

findings about the impact of policy space on the aftermath of financial distress could be contaminated by these other factors. Whether there might be sources of genuinely exogenous variation that could be used to more firmly establish a causal relationship is therefore a very useful topic for further research.

DATA APPENDIX

This appendix describes the sources for our data on interest rates, government debt and budget surpluses. As we discuss, different organizations give somewhat different figures for countries' debts and surpluses, and there are some differences in the interest rate series across countries. However, given the enormous differences across episodes in interest rates and fiscal positions, minor conceptual differences and moderate measurement error are unlikely to be important to our results.

Interest rates

When it is readily available, we use the announced target of the central bank for its focal policy rate, such as the Federal Reserve's target for the federal funds rate for the USA. However, if the central bank describes monetary policy in terms of an administered interest rate rather than a market rate (as is the case with many discount rates), then we do not use the central bank interest rate. For periods when a suitable central bank rate is not available, we splice the central bank rate to an interbank rate. We generally use the immediate call rate when it is available, and otherwise use the three-month interbank rate. Likewise, if the central bank switches the rate that it targets, then we splice the two target rates.

In general, we perform the splices in levels.[29] However, in three cases described below (involving Norway, the UK and the USA), the relationship between two interest rate series that we are connecting was unusual at the point where we connect the series, so that simply linking the two series with no adjustment appears to provide a more accurate treatment of the usual relationship between the two series than splicing them in levels.

Throughout, our interest rate observations correspond to the end of the half-year. For the central bank's target rate, our observations correspond to the target in effect at the end of the half-year. For the interbank rates, we use the average for the last month of the half-year. The policy rate targets were collected directly from central bank websites in January 2017. The interbank rates, which are originally from the OECD, are from Federal Reserve Economic Data (FRED, https://fred.stlouisfed.org, downloaded 8 January 2017). However, because FRED is missing the three-month interbank rate for Greece before January 2001 and the immediate call rate for Japan after March 2015, we obtain those directly from the OECD (http://stats.oecd.org, downloaded 8 January 2017).

With two exceptions, the different interest rates that we consider for each country move together very similarly. As a result, our exact choices of interest rates are of little importance.[30] We are able to obtain interest rate data for 89% of the observations for our full sample period of 1980–2015, and for all of the observations where our measure of financial distress is positive.

The specifics of our interest rate data are as follows:

For the eleven countries in our sample that have belonged to the euro since its inception, we use the European Central Bank's interest rate on main refinancing operations (MRO) for 1999:1–2015:2 (from https://www.ecb.europa.eu/stats/monetary/rates/html/index.en.html). We splice this rate to the immediate call rate for France, Germany and Spain (all back to 1980:1), and to the three-month interbank rate for Austria (back to 1989:1), Belgium (1980:1), Finland (1987:1), Ireland (1984:1), Italy (1980:1), the Netherlands (1986:1) and Portugal (1985:2). Neither interbank rate is available for Luxembourg before 1999, so our interest rate series for Luxembourg begins in 1999.[31]

For Greece, which joined the euro at the beginning of 2001, we use the MRO rate back to 2001:1, then splice to the three-month interbank rate back to 1994:1.[32]

For Australia, we use the Reserve Bank of Australia's target for the cash rate back to 1990:1 (from www.rba.gov.au/statistics/cash-rate); for 1990:1, where the bank reports the target as a range with a width of 50 basis points, we use the midpoint of the range. We then splice that series to the three-month interbank rate back to 1980:1.

For Canada, we use the Bank of Canada's target for the overnight rate back to 2001:1 (which is when the Bank of Canada began to make that series the focus of its public discussions of monetary policy—see www.bankofcanada.ca/core-functions/monetary-policy/key-interest-rate/history-key-interest-rate). The data for the past ten years only are available on the bank's website (www.bankofcanada.ca/rates/interest-rates/canadian-interest-rates). For 2001:1–2006:2, the data are from FRED (series INTDSRCAM193N, downloaded 8 January 2017). We splice this series to the immediate call rate, which goes back to 1980:1.

For Denmark, the Danmarks Nationalbank describes policy in terms of several interest rates. The one on which it places the most emphasis and that market rates appear to track most closely is its interest rate on certificates of deposit. We therefore use this interest rate back to 1992:1 (from www.nationalbanken.dk/en/pressroom/press_releases/Pages/default.aspx?date = FilterAll, www.nationalbanken.dk/en/marketinfo/official_interestrates/Pages/default.aspx and www.nationalbanken.dk/_vti_bin/DN/DataService.svc/OfficialRatesXML?lang = en&interesttype = indskudsbevis), and then splice to the three-month interbank rate back to 1987:1.

For Iceland, we start with the Central Bank of Iceland's interest rate on seven-day term deposits back to 2014:2, and then splice its 'deposit' or 'current account' rate back to 2009:2 (both available from www.cb.is/monetary-policy/monetary-policy-committee and http://hagtolur.sedlabanki.is/is/data/set/231e/#!ds = 231e!2epz = 4.l.6.k&display = line&s = 9ky&title = CBI%27s + Interest + Rates). We then splice to the immediate call rate back to 1998:1, and finally splice to the three-month interbank rate back to 1987:2.

For Japan, we use the Bank of Japan's target for the uncollateralized overnight call rate (from https://www.boj.or.jp/en/mopo/mpmdeci/mpr_2017/index.htm) for the period 1998:2–2012:2. For a few periods, the target is described as a range with a width of 10 basis points; for these periods we use the midpoint of the range. The bank stopped describing monetary policy in terms of any target interest rate at the start of 2013. We therefore splice the target to the immediate call rate both back to 1985:2 and forward to 2015:2.

For New Zealand, we use the Reserve Bank of New Zealand's official cash rate back to 1999:1 (from www.rbnz.govt.nz/monetary-policy/official-cash-rate-decisions), splice to the immediate call rate back to 1985:1, and then splice to the three-month interbank rate back to 1980:1.

For Norway, we use the 'sight deposit rate' back to 1993:1, then splice to the overnight lending rate for banks (also referred to as the 'D-loan rate') back to 1986:1 (both from www.norges-bank.no/en/Monetary-policy/Key-policy-rate/Key-policy-rate-Monetary-policy-meetings-and-changes-in-the-key-policy-rate). We then splice this series to the immediate rate back to 1982:1. Finally, because the average levels of the immediate rate and the three-month rate are very similar over the course of 1982 but three percentage points apart in the final month of 1982:1, we simply connect the immediate rate and the three-month rate without any adjustment, rather than splicing the series, and thereby carry the series back to 1980:1.

For Sweden, we use the Sveriges Riksbank's repo rate (from www.riksbank.se/en/Monetary-policy/Forecasts-and-interest-rate-decisions/Repo-rate-table/?all = 1) back to 1994:1. Although a series for the immediate call rate is available before then, it appears to be an administered rate—it is constant for long periods and moves much less than the three-month interbank rate or the rate on three-month Treasury securities. We therefore splice the repo rate to the three-month interbank rate, which goes back to 1982:1.

For Switzerland, we use the Swiss National Bank's target for the three-month LIBOR rate (from https://www.snb.ch/en/iabout/monpol/monstat/id/monpol_monstat_zielband) back to 2000:1. The target is always expressed as a range, usually with a width of one percentage point. We use the bottom of the range, on the grounds that it is generally quite close to the immediate call rate. We splice this series to the immediate call rate back to 1980:1.

For Turkey, the Central Bank of the Republic of Turkey reports both a borrowing rate and a lending rate back to 2002:1 (both from www.tcmb.gov.tr/wps/wcm/connect/tcmb + en/tcmb + e

n/main + page + site + area/cbrt + policy + rates/cbrt + interest + rates). At most times, the lending rate is several percentage points above the borrowing rate. Because the immediate call rate is generally very close to the borrowing rate, we use the borrowing rate. We splice this series to the immediate call rate back to 1986:1.

For the UK, we use the Bank of England's official bank rate back to 2006:1, then splice to what it called the repo rate back to 1997:1 (both from www.bankofengland.co.uk/monetarypolicy/Pages/decisions.aspx), and then link to the immediate call rate back to 1980:1. The immediate rate is generally very close to the repo rate. However, in the last month of 1997:1, it is 28 basis points lower. Since this does not reflect the usual relationship between the two series, we link the two series without any adjustment rather than splicing the immediate rate to the repo rate.

Finally, for the USA, we use the Federal Reserve's publicly announced target for the federal funds rate back to 1990:2 (from https://www.federalreserve.gov/monetarypolicy/openmarket.htm), then connect to the immediate call rate back to 1980:1. Similarly to the UK, the immediate rate in the USA (which is the federal funds rate) is generally very close to the central bank's target. However, in the last month of 1990:2, it is higher by 31 basis points. Since this does not reflect the usual relationship between the two series, we link the two series without any adjustment rather than splicing the immediate rate to the target rate.

Fiscal data

Both the IMF and the OECD provide data on government debt and the government budget surplus for the countries in our sample. Although their data are not identical, they generally move reasonably well together. The OECD reports the debt series on its website only back to 1995, and generally also reports data on the surplus back to the same year. Older issues of the *OECD Economic Outlook* report fiscal data for earlier years, but those data do not line up exactly with the data that the OECD currently reports. The IMF fiscal data generally go back further than the data on the OECD website, and they often go back to 1980. In order to have as much of the data as possible from a single consistent source, we begin with the IMF data. In cases where there are OECD data for years before those covered by the IMF, we splice the IMF data to the OECD data. In all cases, we use the versions of the series that are reported as a percent of GDP.

For government debt, we begin with the series for 'general government gross debt' and for 'general government net debt' from the *IMF World Economic Outlook* October 2016 database (https://www.imf.org/external/pubs/ft/weo/2016/02/weodata/index.aspx, downloaded 6 December 2016). We obtain the current OECD data on 'gross debt of general government' and 'financial net worth, general government' (the latter multiplied by -1 so that it reflects debt rather than assets) from the OECD website (downloaded 5 January 2017). For the few countries where the current OECD data go back further than reported by the IMF, we splice the IMF series to the corresponding current OECD series. As with the interest rate data, we perform the splices in levels. When there are data in older editions of the *OECD Economic Outlook* that allow us to take the series back further, we splice our series (again in levels) to the data in the *Economic Outlook* for 'gross financial liabilities' and 'net financial liabilities'. We use the December 2002 edition of the *Economic Outlook* to carry the series back to 1985, and the December 1996 edition to carry them back to 1980. Finally, for two countries (Greece and Luxembourg), the IMF has no data on net debt. In these cases, we use the data from the current OECD website with no splicing to the IMF data. (Earlier editions of the *Economic Outlook* do not report net debt data for these countries, so we do not splice the series back in time in these cases.)

For gross debt, we are able to obtain observations for 82% of our sample from the IMF and an additional 12% from the OECD. For net debt, the figures are 66% and 22%. We are able to obtain the series for all of the observations in our sample when our measure of financial distress is positive.

For the surplus, we use the series for 'general government net lending/borrowing' from the *IMF World Economic Outlook* October 2016 database (downloaded 6 December 2016). For cases where the data in older issues of the *OECD Economic Outlook* go back further, we splice the IMF series for the surplus (in levels) to the OECD series for 'financial balance'.[33] We again use the

December 2002 edition to carry the series back to 1985 and the December 1996 edition to carry them back to 1980, and we again splice the series in levels.

We are able to obtain observations for the surplus for 86% of our full sample period of 1980–2015 directly from the IMF, and to fill in another 9% from the *OECD Economic Outlook*. And again, we are not missing the data for any observation for which our measure of financial distress is positive.

The debt and surplus data are annual, while our measure of financial distress is semi-annual. We convert the fiscal data to semi-annual by using the annual observation for year t for both half-years of year t. However, as discussed in the text, when we examine the relationship between fiscal space before a financial crisis and the aftermath of the crisis, we measure fiscal space using the fiscal data two half-years before the crisis. This means that when a crisis occurs in either half-year of year t, we are measuring fiscal space as of year $t - 1$; thus our measures of fiscal space do not reflect any developments in year t. And when we ask how the surplus behaves when there is a crisis, we check our results by also estimating the relationship using only annual data.

NOTES

1. In a contribution that we were not aware of until this paper was in press, Jordà et al. (2016, Section 5.3) examine how the severity of recessions that occur in conjunction with financial crises varies with the pre-recession level of public debt. Jordà et al. use a 0-1 measure of financial crises over a long historical sample. Like us, they find that recessions associated with financial crises are considerably more severe when public debt is higher. They conjecture that this finding results from the impact of high levels of debt on the response of fiscal policy to financial crises. Our results support this conjecture.
2. The data are from the OECD (http://stats.oecd.org, downloaded 10 April 2017). The data are from the Quarterly National Accounts Dataset, series VPVOBARSA. GDP data are missing for a few countries in certain years.
3. The results are slightly different from those in Romer and Romer (2017) because the GDP data have been updated and because we use a shorter sample period. The estimates in the earlier paper used data starting in 1967:1 rather than 1980:1. The most notable difference in the results is that the estimated negative aftermath of financial crises is somewhat less persistent when the shorter sample is used.
4. The standard errors used to form the confidence bands are conventional standard errors. As discussed in Romer and Romer (2017), alternatives, such as heteroscedasticity-consistent and heteroscedasticity- and serial-correlation-corrected standard errors, yield fairly similar results.
5. In several of these episodes, distress reached 7, fell below 7 but did not reach 0, and then hit 7 or higher again. We treat such multi-peaked episodes as a single event.
6. This forecast specification is somewhat different from that in Romer and Romer (2017). The current specification is more consistent with related exercises in Sections II and III. Because the specification in the previous paper did not control for the initial level of distress, the forecast errors were, on average, strongly negative in these crisis episodes. But the results—particularly the variation in forecast errors across episodes—are otherwise very similar.
7. The obvious extreme of this sort of exercise would be to use the level of the policy interest rate as the measure of monetary policy space. We do not go all the way to this extreme because there is not likely to be a substantial difference in the ability to use monetary policy at an initial policy rate of, say, 6% and one of 12%. Indeed, since high policy rates at the start of the crisis sometimes reflect strains in international currency markets, one could imagine scenarios where a very high initial policy rate corresponds to less ability to undertake monetary policy actions.
8. The impulse response function for without monetary policy space is thus just the sequence of the estimated β^i terms. The impulse response function for with monetary policy space is the sequence of the estimates of $\beta^i + \delta^i$.
9. The baseline forecast error is decidedly smaller than in panel C of Figure 3 because in this exercise we also include the level of the monetary policy space variable as a control. This additional term soaks up much (though not all) of the slowdown in growth that occurred in Japan after 1990.

10. Though the regression uses a continuous variable for identifying monetary policy space, for describing the results with and without monetary space, we define without space as corresponding to a value of the policy rate of 0 (which, in the case considered, corresponds to a value of the policy space variable of 0.023), and with space as corresponding to a value of the space variable of 1.

11. Our baseline version of this specification (with the fixed effects and lags not shown for simplicity) is $y_{j,t+i} = \zeta^i S_{j,t} + \beta^i F_{j,t} + \delta^i [F_{j,t} \cdot S_{j,t} \cdot (1 - E_{j,t})] + e_{j,t}^i$, where $E_{j,t}$ is a dummy for whether country j is in the euro area in period t. As before, $S_{j,t}$ is a dummy for whether the policy rate relevant to country j at the end of period $t - 1$ (that is, the policy rate of the country's central bank for observations not in the euro area, and the ECB's policy rate for observations in the euro area) is over 1.25%. The logic for controlling for $S_{j,t}$ rather than for $S_{j,t} \cdot (1 - E_{j,t})$ (that is, for including the $\zeta^i S_{j,t}$ term rather than a $\zeta^i S_{j,t} \cdot (1 - E_{j,t})$ term) is that one can think of reasons that not being at the zero lower bound might affect output (or be correlated with factors that might affect output); but it is harder to see why being in the euro area would directly affect output. And it certainly does not seem reasonable to force not being at the zero lower bound and not being in the euro area to have the same output effects. However, we have also considered the specification that controls for both $S_{j,t}$ and $E_{j,t}$ (and their lags). When we do this, the maximum output decline following an impulse of 7 to financial distress is 6.4% without monetary policy space and 3.1% with space. Even in this case, the difference between the two responses is statistically significant at horizons of three years or more.

12. In this case, the basic specification (with the fixed effects and lags again not shown for simplicity) is $y_{j,t+i} = \zeta^i S_{j,t} + \beta^i F_{j,t} + \delta^i [F_{j,t} \cdot S_{j,t} \cdot (1 - E_{j,t}) + \overline{F_t^E} \cdot S_{j,t} \cdot E_{j,t}] + e_{j,t}^i$, where $\overline{F_t^E}$ is the GDP-weighted average level of financial distress in the euro area in period t. Thus this specification allows for monetary policy space to respond to financial distress if a country is not in the euro and its policy rate is not close to the zero lower bound, and to respond to euro area distress, but not country-specific distress, if the country is in the euro and the ECB policy rate is not close to the zero lower bound.

13. Note that although we end up considering similar non-linear functions as variants of our baseline measures for both monetary and fiscal space, the routes by which we get there are different. Our baseline measure of monetary policy space (a dummy variable that switches from 0 to 1 at a policy interest rate of 1.25%) is a highly non-linear function of the interest rate. We then consider the cumulative normal as a less extreme form of this non-linear function. In contrast, for fiscal policy space, our baseline measure is a linear function of the debt-to-GDP ratio. We then consider the cumulative normal as a non-linear variation on the linear baseline.

14. One limitation to this additional measure of fiscal space is that in our sample, being subject to the SGP is correlated with other factors affecting the aftermath of financial distress. Most notably, the countries that faced high sovereign risk spreads following the 2008 global financial crisis, and that in some cases required bailouts that were conditional on severe austerity, were generally subject to the SGP. Since those factors probably worsened the aftermath of the crisis in those countries, estimates of the impact of the SGP are likely to be biased toward overstating any negative effect of the SGP.

15. The impulse response function for without fiscal policy space is thus the sequence of the estimates of $\beta^i - 96 \cdot \delta^i$. The impulse response function for with fiscal policy space is the sequence of the estimates of $\beta^i - 27 \cdot \delta^i$.

16. Paralleling our approach for the gross debt-to-GDP ratio, in summarizing the results for the net debt ratio we define without fiscal policy space as corresponding to a net debt-to-GDP ratio one standard deviation (44.6%) above the sample mean (29.8%), and with fiscal space as corresponding to a net debt ratio one standard deviation below the mean. Importantly, as before, the fiscal space variable itself is continuous in the estimation.

17. Because the non-linear function is based on gross debt, we again define with and without fiscal policy space in terms of a gross debt-to-GDP ratio one standard deviation below or above the sample mean.

18. In this way of summarizing the results, we define without policy space to correspond to a value of the dummy variable for monetary policy space of 0 and a debt-to-GDP ratio one standard deviation above the mean, and with policy space to correspond to a value of the dummy variable of 1 and a gross debt-to-GDP ratio of one standard deviation below the mean.

19. If in forming the forecast without the interaction effects, we also exclude the levels of the two policy space variables, then the difference is slightly larger.

20. Girouard and André (2005) report the change in the surplus-to-GDP ratio in response to a rise of 1 percentage point in the difference between actual and potential GDP for most OECD countries for three years (1996, 2000 and 2003) based on the associated tax codes and other evidence about the cyclical behaviour of each country's tax base and unemployment rate. For the 23 countries in our sample for which they provide an estimate (Turkey is not included in their study), the average across the three years is 0.45.

21. Throughout, we multiply the sensitivity parameter by the change in output, rather than by an estimate of the change in the output gap. The reason is that the product of a country's normal GDP growth and the sensitivity parameter is constant over time, thus is captured by the fixed effect for the country. That is, we can rewrite $\tau \cdot [(y_{j,t+i} - \overline{y}_{j,t+i}) - (y_{j,t-1} - \overline{y}_{j,t-1})]$ as $\tau \cdot (y_{j,t+i} - y_{j,t-1}) - \tau \cdot (\overline{y}_{j,t+i} - \overline{y}_{j,t-1}) = \tau \cdot (y_{j,t+i} - y_{j,t-1}) - \tau \cdot (i + 1) \cdot g_j$, where $\overline{y}_{j,t}$ is potential output in country j at time t, and g_j is normal growth (per half-year) in country j. Since $\tau \cdot (i + 1) \cdot g_j$ does not vary over time within a country, subtracting it from the left-hand side variable would affect only the estimates of the country fixed effects. Leaving it out therefore does not

affect the estimates of the key coefficient of interest, δ^i, and allows us to avoid having to estimate trend growth for each country.

22. We convert real GDP and our financial distress variable to annual by averaging the semi-annual observations.

23. Since our measure is defined in terms of changes, we need to choose a base period. In each episode, the base period is set two half-years before financial distress reached 7. In addition, in contrast to when we estimate equation (4), where each country's trend growth is subsumed in the country fixed effect, to actually form estimates of the change in the high-employment surplus we need an explicit measure of trend growth by country. We use each country's average growth over our full sample period, 1980:1–2015:2.

24. Since this number is very large, it is perhaps useful to describe what in the procedure gives rise to it. From a year before its financial distress reached 7 to three years after, Greece's actual surplus rose by roughly 4% of GDP (from -10.2% to -6.5%). In addition, using the change in logarithms, actual GDP fell by 27%; since Greece's average growth over our sample period is roughly 0.8% per year, our approach implies that the difference between actual and potential output fell by about 30 percentage points. Our sensitivity parameter of 0.4 then implies that this change reduced the actual surplus relative to the high-employment surplus by about 12% of GDP. Thus we estimate an overall swing in the high-employment surplus of 16% of GDP. Although one can imagine various refinements of this calculation, it is hard to avoid the conclusion that the swing was enormous.

25. The measure of fiscal policy space is again the negative of the gross debt-to-GDP ratio. For this summary, we again define with fiscal policy space as corresponding to a debt ratio one standard deviation below the sample mean, and without fiscal policy space as corresponding to a debt ratio one standard deviation above the mean.

26. Importantly, as discussed above, these estimates may not reflect a causal impact of the SGP. Consider Greece following the 2008 global financial crisis, for example. It was subject to the SGP, so the large increase in its high-employment surplus contributes to the estimate of a negative coefficient on the interaction effect for not being subject to the SGP. But in fact, Greece's large fiscal contraction appears to have been the result mainly of a loss in market confidence and conditions imposed as part of its bailout package, and not of the fact that it was subject to the SGP.

27. The measure of fiscal policy is the annual analogue of our rough estimate of the high-employment surplus, and the measure of fiscal policy space is the negative of the gross debt-to-GDP ratio in the previous year.

28. As usual, with policy space corresponds to a value of the monetary policy space dummy variable of 1 and a gross debt-to-GDP ratio one standard deviation below the sample average, and without policy space corresponds to a value of the monetary policy space dummy of 0 and a gross debt-to-GDP ratio one standard deviation above the sample average.

29. That is, if we use the central bank's target rate back to period t and an interbank rate to period $t-1$, then we add the difference between the target rate and the interbank rate in period t to all the observations using the interbank rate. This ensures that the change from period $t-1$ to period t in our series is the same as that in the interbank rate. If yet more series are needed to go back further, then we perform those splices in levels as well.

30. The two exceptions, which are discussed below, involve the immediate call rate reported by the OECD for Greece, which appears to be erroneous for the relevant period, and the immediate call rate reported by the OECD for Sweden, which appears to be an administered rate for the relevant period. We do not use these interest rates.

31. The June 1989 three-month interbank rate for Portugal is missing, so we use the May 1989 value instead for 1989:1.

32. The OECD reports an immediate call rate for Greece for 1999 and 2000 that is identical to the euro area call rate. However, this series is grossly contradicted by the behaviour of the three-month interbank rate in Greece in this period, as well as by an account of monetary policy in Greece during the transition to the euro (http://www.bis.org/review/r000308b.pdf, accessed 15 January 2017). This series does not appear to accurately reflect interest rates in Greece in 1999–2000, so we do not use it.

33. There are two cases where we could potentially use some current OECD data to carry the IMF data back: Australia and the USA. However, for Australia, the current OECD series moves very differently from the IMF series in the period of overlap, while the series in the 2002 *Economic Outlook* does not. Since this difference raises concerns about the comparability of the current OECD and IMF data, we do not to use the current OECD data in either of these two cases.

REFERENCES

AMANO, R. and SHUKAYEV, M. (2012). Risk premium shocks and the zero bound on nominal interest rates. *Journal of Money, Credit, and Banking*, **44**(8), 1475–505.

BERNANKE, B. S. (1983). Nonmonetary effects of the financial crisis in the propagation of the Great Depression. *American Economic Review*, **73**(3), 257–76.

BOHN, H. (1998). The behavior of U.S. public debt and deficits. *Quarterly Journal of Economics*, **113**(3), 949–63.

BORDO, M., EICHENGREEN, B., KLINGEBIEL, D. and MARTINEZ-PERIA, M. S. (2001). Is the crisis problem growing more severe? *Economic Policy*, **16**(32), 51–82.

CORSETTI, G., MEIER, A. and MÜLLER, G. J. (2012). What determines government spending multipliers? *Economic Policy*, **27**(72), 521–65.

GIROUARD, N. and ANDRÉ, C. (2005). Measuring cyclically-adjusted budget balances for OECD countries. OECD Economics Department Working Paper no. 434.

ILZETZKI, E., MENDOZA, E. G. and VÉGH, C. A. (2013). How big (small?) are fiscal multipliers? *Journal of Monetary Economics*, **60**(2), 239–54.

JORDÀ, Ò. (2005). Estimation and inference of impulse responses by local projections. *American Economic Review*, **95**(1), 161–82.

———, SCHULARICK, M. and TAYLOR, A. M. (2013). When credit bites back. *Journal of Money, Credit and Banking*, **45**(s2), 3–28.

———, ——— and ——— (2016). Sovereigns versus banks: credit, crises, and consequences. *Journal of the European Economic Association*, **14**(1), 45–79.

KAMINSKY, G. L. and REINHART, C. M. (1999). The twin crises: the causes of banking and balance-of-payments problems. *American Economic Review*, **89**(3), 473–500.

KOSE, M. A., KURLAT, S., OHNSORGE, F. and SUGAWARA, N. (2017). A cross-country database of fiscal space. World Bank Development Prospects Group, Policy Research Working Paper no. 8157.

LAEVEN, L. and VALENCIA, F. (2014). Systemic banking crises. In S. Claessens, M. A. Kose, L. Laeven and F. Valencia (eds), *Financial Crises: Causes, Consequences, and Policy Responses*. Washington, DC: International Monetary Fund, pp. 61–137.

MENDOZA, E. G. and OSTRY, J. D. (2008). International evidence on fiscal solvency: is fiscal policy 'responsible'? *Journal of Monetary Economics*, **55**(6), 1081–93.

OBSTFELD, M. (2013). On keeping your powder dry: fiscal foundations of financial and price stability. *Monetary and Economic Studies*, **31**(1), 25–38.

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT (various years). *OECD Economic Outlook*. Paris: OECD Publishing.

PEROTTI, R. (1999). Fiscal policy in good times and bad. *Quarterly Journal of Economics*, **114**(4), 1399–436.

REINHART, C. M. and ROGOFF, K. S. (2009). *This Time is Different: Eight Centuries of Financial Folly*. Princeton, NJ: Princeton University Press.

ROMER, C. D. and ROMER, D. H. (2017). New evidence on the aftermath of financial crises in advanced economies. *American Economic Review*, **107**(10), 3072–118.