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Financial Crises and the Composition of Public Finances: Evidence from OECD Countries*

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Abstract

The effects that financial crises exert on public debt-to-GDP ratios have received substantial attention in policy circles and academia alike. We add to this discussion by exploring the impact of financial crises on the composition of public spending and tax revenues. Using the Jordá (2005) local projection approach and data from 23 advanced OECD countries, ranging from 1970 to 2016, we find that expenditures on social security and on interest payments increase relative to total spending, whereas the share of public investment expenditures declines in the aftermath of financial crises. This shift in expenditure composition mainly arises in highly financially developed economies. Our results are also indicative for a financial crisis-induced shift to more long-run economic growth-friendly types of revenues. However, this shift mainly occurs in less financially developed economies.

Keywords: Composition of public budgets, financial crisis, public debt

JEL codes: E06, G01, H01, H05

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1 Introduction

The effects exerted by financial crises have received a substantial amount of attention in policy circles and academia alike. In this paper we add to this literature by exploring whether financial distress also influences the composition of public spending and tax revenues. In other words, we study fiscal policy outcomes at disaggregated levels in the aftermath of a financial crisis, whereas the existing literature has focused on aggregate outcomes, predominately the debt-to-GDP ratio (cf. Section 2).

The focus on outcomes at disaggregated levels informs whether financial distress is paired not only with high fiscal costs in form of increasing public debt ratios, but also with changes in the quality of public finances[1] which, in turn, may impact on countries' long-run economic growth performance.

Compositional changes in public finances in the wake of financial distress may occur through several channels. Output losses associated with a financial crisis[2] will directly give rise to changes in public spending and tax revenues through automatic stabilizers. And since automatic stabilizers work primarily through social benefits and lower revenues from personal and corporate income taxes (see, e.g., Dolls et al., 2012), these categories should be affected disproportionately after a financial crisis.

While these effects represent rather direct and largely mechanical consequences on the composition of public finances, financial distress may also exert more indirect effects. The latter occur if governments favor certain tax and spending categories over others, when they implement discretionary stabilization policies (see, e.g., Ha and Kang, 2015). In this sense, a financial crisis can be viewed as a "window of opportunity" to deliberately

[1]The quality of public finances is concerned with expenditure and revenue structures that are conducive for long-run economic growth. See, for example, European Commission (2012) on the quality of public expenditures and Arnold et al. (2011) on the quality of taxation.

[2]Laeven and Valencia (2014) show that in advanced countries the median output loss from financial crises prior to 2007 is about 33 percent of GDP. Claessens and Kose (2014) argue that recessions associated with financial crises are longer and deeper. Romer and Romer (2016) find that the average decline in output following a financial crisis in industrialized countries is statistically significant and persistent, albeit only of moderate size. Jordá et al. (2015) find that financial crises tend to be followed by deeper recessions and slower recoveries if the crises were preceded by credit booms and asset price bubbles.

re-orient spending and revenue structures to improve the quality of public finances and to increase the economy's growth potential through a shift towards productive spending categories and through reducing distortionary effects of the tax system.

However, financial distress need not incentivize governments to improve the structure of public finances. Rather, discretionary fiscal policies may be primarily implemented with the aim to cushion the short-run macroeconomic impact of financial distress, rather than improving the long-run growth potential of an economy. In this case, shifts in the composition of public finances are possible if governments deal with the fiscal consequences of stabilization policies by not just reversing changes in spending and tax revenues (Arnold et al., 2011). Put differently, governments dealing with a crisis-induced worsening of its debt positions may again focus on certain types of taxes, regardless of what categories of tax revenues were particularly affected in the wake of financial distress. For similar reasons, spending cuts may also not be symmetric across categories and may not be limited to categories that witnessed increases immediately following the crisis.[3]

Finally, financial crisis may give rise to structural changes in the economy which influence the composition of public finances. For instance, as the unemployed become de-qualified and de-motivated during long spells of unemployment, the unemployment rate may increase persistently resulting in structurally higher levels of expenditures on social benefits relative to other spending categories. And, financial distress may lead to lasting changes in interest rates on government debt which alter costs of debt service and, thus, the share of interest payments in total expenditures (see, e.g., International Monetary Fund, 2009, chapter III).

Against this background, we explore whether financial crises not only lead to changes in debt-to-GDP ratios, but also to changes in tax and expenditure structures and, ultimately, in the quality of public finances. Our main measure for financial distress is the indicator developed by Romer and Romer (2016). We apply the Jordá (2005) local projection method to characterize the dynamic behavior of fiscal variables in the eight years following a financial crisis. Our sample comprises 23 OECD countries over the period 1970 to 2016.

[3]These compensating increases and decreases in taxes and expenditures, respectively, may not be guided by the aim to improve the quality of public finances. For anecdotal evidence that this has happened in the European Union in the aftermath of the recent global financial crisis, see Rehn (2014).

Our findings indicate that financial crises are typically associated with a lasting increase in expenditures on social security and in interest payments relative to total spending, and with a corresponding decline in the share of public investment expenditures. This shift in expenditure composition away from directly productivity enhancing public investments mainly arises in highly financially developed economies. Our results are also indicative for a financial crisis-induced shift to more long-run economic growth-friendly types of revenues. However, this shift mainly occurs in less financially developed economies.

The remainder of the paper is organized as follows: Section 2 briefly summarizes the key findings of related literature. In Section 3 we describe the empirical methodology and the data used in the analysis. Section 4 presents baseline estimation results and Section 5 contains findings from robustness checks. Section 6 explores the link between the effects of financial distress and the level of financial development. Section 7 summarizes and concludes the paper.

2 Related Literature

Cross-country studies dealing with fiscal effects of financial distress are still rather scarce and available studies put a clear focus on crisis' effects on debt-to-GDP ratios. Based on a broad sample of countries and long time series, Reinhart and Rogoff (2009) find that (real) central government debt cumulatively increases by more than 86 percent in the three years following a systemic banking crisis. Moreover, these authors stress that the increase is mainly driven by a sharp drop in tax revenues due to the deep recessions that accompany most severe banking crises (Reinhart and Rogoff, 2009, chapter 14). In the advanced economies contained in their sample, real central government tax revenue growth is negative not only in the year of the banking crisis but also in the two following years. For emerging economies the turnaround of growth rates comes somewhat faster due to a swifter recovery in real economic growth (Reinhart and Rogoff, 2009, chapter 10).

Laeven and Valencia (2014), too, find a substantial increase in public debt in the wake of a systemic banking crisis. These authors distinguish between advanced economies and emerging markets on the one hand and between banking crises prior to 2007 but after 1970

and the recent global crisis on the other hand. According to Laeven and Valencia (2014) the median increase in public debt due to the 2007 - 2009 crisis is close to 25 percent of GDP for both, advanced and emerging economies. Thereby, the increase in public debt is measured as the change in the debt-to-GDP ratio during the four-year period starting with the crisis year (Laeven and Valencia, 2014, p. 416). For systemic banking crises prior to 2007 they find a corresponding median increase in the public debt-to-GDP ratio of 16 percent.

Furceri and Zdzienicka (2012a) use the Jordá (2005) approach on a broad sample of 154 developed and developing countries from 1980 to 2006 and find that systemic banking crises lead to a substantial increase in public debt levels. They also show that the increase crucially depends on the severity of the crisis. Severity is judged based on output loss due to the financial crisis. They find that for banking crises which are paired with a deviation of the annual growth rate from the average trend of more than 4 percent, the increase in the public debt-to-GDP ratio is about 37 percentage points after 8 years from the start of the crisis. However, for less severe crises the measured impact is substantially lower at about 8 percentage points of GDP.

Tagkalakis (2013) analyzes the effects of the recent global financial crisis, a systemic (global) banking crisis, on public debt-to-GDP ratios in 20 OECD countries. He adjusts the debt-to-GDP ratio for a snow-ball effect. Thus, the development of his endogenous variable is not driven by growth and inflation effects. Tagkalakis (2013) *inter alia* finds that the increase in the adjusted debt ratio depends on the size of the financial sector. Thereby, the latter is approximated by the ratio of outstanding credit to the private sector as percent of GDP. He also establishes that the recent global financial crisis leads to a larger deterioration of the budget balance in countries with larger financial sectors. Thus, his results are consistent with the view that larger financial sectors lead to a larger increase in the debt-to-GDP ratio due to larger fiscal interventions of governments. Moreover, as a bigger financial sector may imply a more severe financial crisis, the findings of Tagkalakis (2013) are consistent with the conclusions derived by Furceri and Zdzienicka (2012a).

The size of the financial sector is key for the fiscal costs of financial crises also according to Schularick (2012) who focuses on financial crises in 14 industrial economies over 140

years. Schularick (2012) finds that financial crises are an important determinant of public debt ratios in the late twentieth century. One reason for this pronounced importance of financial crisis for public debt lies in the attempts of governments to stabilize the economy in the aftermath of financial distress. Schularick (2012) shows that the fiscal costs of financial crises increase with the size of the financial sector. And, he finds that financial crises strongly depress real government revenues while the effect on real government expenditures is negligible.

In a nutshell, recent literature is consistent with the view that financial crises exert a significant impact on fiscal positions. The focus, however, clearly is on fiscal aggregates in general and public debt-to-GDP ratios in particular. In contrast, the extent and dynamics of a financial crisis' impact on general governments' expenditure and tax revenue composition are largely unexplored. Our study narrows this gap in the literature.

3 Empirical Methodology and Data

3.1 Empirical Methodology

We apply the local projection approach developed by Jordá (2005) to explore the impact of financial distress on the dynamics of fiscal positions over the short- and medium-run.[4] Specifically, we estimate impulse response functions (IRFs) by running regressions of the type:

$$Fiscal_{it+h} - Fiscal_{it} = \sum_{n=1}^{2} \alpha_n^h \Delta\, Fiscal_{it-n} + \sum_{m=0}^{2} \beta_m^h FC_{it-m} + \sum_{l=1}^{k} X'_{lit-1}\gamma_l^h + \lambda_i^h + \kappa_t^h + \epsilon_{it+h}, \tag{1}$$

for each forecast horizon h, where $Fiscal_{it}$ is a fiscal policy outcome variable, such as expenditure and tax revenue shares in GDP or revenues from a specific tax as a share of total tax revenues. FC_{it} measures the extent of financial distress in a country i in year t and X_{it-1} is a vector of lagged control variables.[5] λ_i are country fixed-effects, κ_t^h captures

[4] See e.g. Jordá et al. (2013), Furceri and Zdzienicka (2012a,b), and Afonso and Jalles (2017) for recent applications of this approach.

[5] Unit root tests of the first (Maddala-Wu) and second generation (Pesaran-CIPS (Z-tbar statistic)) indicate that most variables are I(1). Control variables which are tested to be I(1), enter X'_{lit-1} in first

time fixed-effects in our baseline estimations[6] and ϵ_{it} is the regression error term.

To capture short- and medium-run effects of financial distress, we consider forecast horizons of up to eight years, $h = 1, ..., 8$ (see e.g. Furceri and Zdzienicka, 2012a). The estimated coefficients $\hat{\beta}_0^h$ provide an estimate of the impulse response (IR) at forecast horizon h. The corresponding 90-percent confidence interval is calculated using the standard errors of $\hat{\beta}_0^h$.

We include lagged dependent variables in Equation 1 to capture inertia in fiscal positions due to path dependence and longer-run spending commitments. Lags of FC_{it} are considered to cope with serial correlation in the occurrence of financial distress.

While local projections are robust to mis-specification of the data generation process (see, e.g., Afonso and Jalles, 2017; Ramey, 2016, for advantages of local projections over alternatives), a crucial requirement for consistent estimation of $\hat{\beta}_0^h$ is the exogeneity of the impulse variable FC_{it}. The main indicator for FC_{it} which we use (cf. section 3.3), classifies years with financial distress based on the cost of financial intermediation. Importantly, fiscal variables do not play a relevant role as predictor of the cost of financial intermediation (see Demirguc-Kunt et al., 2004). Thus, reverse causality should not pose a serious problem for our application. And, we cope with the possibility of an omitted variable bias by including a variety of control variables in X'_{lit-1} (cf. Section 3.4).

Our sample comprises Australia, Austria, Belgium, Canada, Switzerland, Germany, Denmark, Spain, Finland, France, United Kingdom, Greece, Ireland, Iceland, Italy, Japan, Luxembourg, Netherlands, Norway, New Zealand, Portugal, Sweden and the United States of America. Estimations are carried out for the years 1970 to 2016. Hence, the analysis includes the global financial crisis starting in 2007 as well as regional and country-specific financial crises.

While a Nickel-bias in the estimation results is negligible given the rater long time series (Judson and Owen, 1999)[7], we calculate standard errors using a HAC-robust variance-covariance matrix as the error term has a moving average (MA) representation (e.g., Ramey, 2016).

differences.

[6] In a robustness analysis, we replace time fixed effects with country-specific trends.

[7] The finite sample bias equals $1/T$ (e.g., Afonso and Jalles, 2017), which is $<= 1/36$ in our estimations.

3.2 Fiscal Data

To characterize the dynamics of aggregate public finance outcomes in the aftermath of a financial crisis, we use total tax revenues and total expenditures, gross public debt (general government gross liabilities) and the general government budget balance as share in GDP as dependent variables in equation 1. Expenditure, debt and deficit / surplus data are taken from National Accounts as provided by the Economic Outlook database. Revenue data are taken from OECD's Revenue Statistics. Data are defined for the general government.

To study the effect of financial crises on the composition of public finances, we follow National Accounts and Revenue Statistics classifications, respectively, to define different spending and revenue categories. On the spending side, we consider 5 categories.[8] Category 1 comprises social security expenditures (OECD category SSPG), Category 2 is public investment expenditure (OECD: IGAA) and Category 3 is government consumption expenditure (OECD: CGAA). Category 4 comprises other current expenditures plus property income paid excluding interest payments (OECD: YPOTG + YPEPG - GGINTP). Category 4 includes to a large extent subsidies paid by the government sector (OECD: TSUB). Category 5 comprises interest payments (OECD: GGINTP).

We normalize each spending category by total expenditures of general government (TOTEXP), which we define as TOTEXP = SSPG + CGAA + YPOTG + YPEPG + IGAA. Hence, we exclude National Accounts category 'Capital Transfers paid and other capital payments' from total expenditures. This latter category includes high one-off payments, for example, due to transfers to public enterprises. These payments may blur the relationship between financial crises and the composition of public expenditures if total disbursements are used as denominator.[9]

On the revenue side we, too, distinguish five tax categories. We study revenues from all taxes on income, profits and capital gains (OECD: 1000; 'direct taxes'; Category 1), from all taxes on goods and services (OECD: 5000; 'indirect taxes'; Category 2) as well

[8] A finer classification of expenditure categories, like the COFOG classification, cannot be used due to lack of long time-series for most of the countries included in the analysis.

[9] For instance, large increases in Capital Transfers paid are recorded in 1998 and 2000 for Japan. In 1998 this was due to high capital transfers to the Japan National Railways (see Leigh et al., 2011).

as from social security contributions (OECD: 2000; Category 3) and from property taxes (OECD: 4000; Category 4). Taxes from payroll and workforce (OECD: 3000) as well as 'other taxes' (OECD: 6000) are included in Category 5. These categories are normalized by total tax revenues, which are the sum of OECD tax categories 1000 to 6000.

3.3 Financial Crisis Indicator

We use the indicator introduced by Romer and Romer (2016) as our main proxy variable for financial distress. Using a narrative approach, Romer and Romer (2016) derive years with financial crises from real-time accounts of country conditions prepared by the OECD which indicate increases in the cost of credit intermediation and disruptions in credit supply.

One advantage of the Romer-indicator over binary indicators for (start of) systemic banking crises (e.g., Laeven and Valencia, 2013) is that it captures various intensities of financial distress. Specifically, the Romer-indicator is defined over a 15-points scale with 0 = no financial distress and 15 = very extreme financial crisis. Thus, besides avoiding problems with ex-post coding, the Romer-classification has the advantage of capturing the building-up process of a severe financial crisis (see Gandrud and Hallerberg, 2015). It is conceivable that reactions in fiscal variables, be it automatic or discretionary, already occur before more severe financial distress, like a systemic banking crisis, hits an economy. The Romer-indicator is useful for capturing the effects of less severe forms of financial distress on fiscal positions.

Since the Romer-indicator is available only semi-annually, while our analysis is based on yearly data, we aggregate by using the maximum of the two entries for a particular year. Moreover, Romer and Romer (2016) find that their crisis indicator detects the start of a financial crisis with delay. To cope with this issue we use the forward lag of FC_{it} to estimate $\hat{\beta}_0^h$.

Table 1 summarizes years with financial crises and it indicates the severity of financial distress. Each of the 23 countries in the sample experience financial crises between 1970 and 2016. For many countries this is due to the global financial crisis commencing with the year 2007. In contrast, only ten countries in our sample experience one or more years

with financial distress prior to 2007. Thereby Japan, which experiences every year a minor or major credit disruption from 1990 to 2005, dominates the picture. Japan is also one of the three countries which face episodes of extreme financial crisis. The others are Iceland (2009) and the United States (2008). Credit disruptions ($0 < FC_{it} < 4$), which comprise the weakest forms of financial distress in the Romer-classification, comprise about one-third of all crises episodes. From Table 1 the serial correlation in financial distress is evident, which calls for the inclusion of lagged values of FC_{it} in equation 1.

3.4 Control Variables

We include lagged real GDP growth, $growth_{it-1}$, in the vector of control variables as the macroeconomic environment prior to the financial crisis may influence fiscal outcomes and to control for correlation of the general macroeconomic environment with the likelihood and extent of a financial crisis.

Inflation, $infl_{it-1}$, aims to capture inflation-related effects on expenditure and tax revenue shares like 'bracket creep' in case of progressive tax schedules, the taxation of fictitious profits due to tax deductions based on acquisition value, the decreasing importance of revenues from per unit consumption taxes in case of inflation or the non-indexation of social security expenditures.

We consider the share of population aged 15 to 64 in total population, $popshare_{it-1}$, in our regressions, as it is conceivable that a higher share of dependent persons leads to a higher share of social security expenditures (see Shelton, 2007) and to lower revenues from personal income taxes, from social security contributions and from taxes on payroll and workforce. Real GDP growth and inflation data are taken from OECD's Economic Outlook database. Population data come from WDI database.

Economic openness, kof_{it-1}, is frequently shown to impact on both, level and composition of public budgets (see, e.g. Gemmell et al., 2008; Winner, 2005). The compensation hypothesis (Rodrik, 1998) postulates an increasing importance of social security expenditures with globalization as voters demand insurance against the perceived economic risk exerted by globalization pressures. In contrast, the efficiency hypothesis forecasts a decrease of expenditures and tax revenues as share in GDP in general and a decrease in

non-productive government expenditures in particular due to globalization. The increased possibilities to relocated mobile tax bases make it easier to tame Leviathan-governments (see, e.g., Wilson and Wildasin, 2004, for an overview). In addition, from several tax and expenditure competition theories, it can be derived that in the course of globalization, to attract mobile capital, tax burden is shifted to immobile tax bases (labor income, consumption) and that productive expenditure categories become relatively more important in total expenditures. At the same time, more open economies may be especially prone to the occurrence of a financial crisis. Indeed, Claessens and Kose (2014) report that among the best indicators for the occurrence of a banking crisis are a fall in exports, a high ratio of short-term capital flows and a large current-account deficit relative to investment. We use the KOF-index (see Dreher, 2006) to measure extent and development of economic globalization.

The share of private credit by deposit money banks and other financial institutions in GDP, $privcredit_{it-1}$, is included in revenue share regressions since financial crises are frequently preceded by booms in private credit (Claessens and Kose, 2014). At the same time a high level of private credit may impact on tax structure as interest payments are usually deductible from corporate and personal income tax bases. Thus, like kof_{it-1}, $privcredit_{it-1}$ might be correlated with both, FC_{it} and the share specific taxes have in total tax revenues. Data on $privcredit_{it-1}$ are taken from Beck et al. (2009), updated in Cihak et al. (2012).

In revenue share regressions the vector of control variables additionally includes total general government tax revenues as share in GDP (Tax_{it-1}). This variable intends to capture the possibility that the share of a particular tax in total tax revenues depends on government size. Specifically, with an increasing level of government intervention the number of different types of taxes levied may rise as well, while with smaller governments total tax revenues may comprise only few types of taxes. For a similar reason, we include total general government expenditures as share in GDP ($Disb_{it-1}$) in expenditure share regressions. Tables 2 and 3 provide additional information on the variables used in this study.

4 Baseline Results

Figure 1 shows the responses of fiscal variables as shares of GDP to a moderate financial crisis, based on Equation 1 and the Romer and Romer (2016) measure of financial distress.[10]

Consistent with the related literature (cf. Section 2) we see that a moderate financial crisis leads to a surge in the debt-to-GDP ratio. Eight years after the financial crisis, the debt-to-GDP ratio exceeds its level in the counterfactual of no financial distress by more than ten percentage points.

The budget balance as a percentage of GDP deteriorates by roughly two percentage points after about one year and public expenditures as a share of GDP increase by somewhat more than one percentage point after two years. Like in case of the budget balance, the impact on the expenditure-to-GDP ratio fads out over time. Thus, financial distress has only a short-run impact on these two fiscal positions.

The figure for tax revenues in GDP suggests that the tax-to-GDP ratio declines compared to the counterfactual of no financial distress. And, compared to the expenditure-to-GDP ratio the impact is also longer-lasting as IRs are negative throughout the forecast horizon.

Figure 1, thus, signals that financial distress has short- and medium-run impacts on the debt-to-GDP as well as the tax-to-GDP ratio but it is paired only with temporary effects on public expenditure and deficit ratios.

With respect to the composition of public finances, Figure 2 shows the responses of the various revenue categories as a percentage of total revenues. The figure implies that direct taxes decline relative to total revenues, while indirect taxes increase. This shift in composition also last over the medium-run. After eight years the share of indirect taxes in total tax revenues is somewhat more than one percentage point higher than in the counterfactual situation of no financial distress. Thus, Figure 2 is consistent with the view that financial crises are paired with an economic growth-friendly shift in composition to indirect taxes and, likely, away from direct taxes.

Turning to results for expenditure categories as percentages of total expenditure, Fig-

[10] According to Romer and Romer (2016), a moderate crisis corresponds to $FC_{it} = 7$.

ure 3 shows that a moderate financial crisis leads to significant increases in spending on social security and in interest expenditures, not only in the short- but also in the medium-run. These shifts come at the cost of lower public consumption expenditures and lower public investment spending. While the effect on public consumption fads out over time, the impact on investment spending is visible also in the medium-run.

The effects on the shares of spending on social security, investment expenditures and interest payments are persistent in the sense that although the impact on the expenditure-to-GDP ratio fads out after about three to four years (cf. Figure 1), these compositional changes are still significant after eight years.

Taken together, these findings are consistent with the view that productive, and therefore long-run economic growth enhancing, expenditure categories lose importance in the aftermath of a financial crisis while less growth-friendly categories gain share in total expenditures.

5 Robustness Analyses

We support our baseline results by three robustness checks. We first consider the Laeven and Valencia (2013) indicator for systemic banking crises as alternative to the Romer-indicator for financial distress. Second, we present results based on estimations with the variables entering in levels rather than differences and, finally, we re-run baseline regressions with country-specific time trends instead of time dummies.

5.1 Alternative Crisis Indicator

An alternative to the crisis indicator developed by Romer and Romer (2016) is the indicator for systemic banking crises advanced by Laeven and Valencia (2013). This binary indicator signals the start of a systemic banking crisis based on: (i) significant signs of financial distress in the banking system (bank runs, significant losses in the banking system, bank liquidations) and (ii) significant banking policy intervention measures in response to significant losses in the banking system. The first year in which both criteria are met is considered as the start year of the systemic banking crisis.

Table 7 contains the starting years of systemic banking crises for the countries included in our sample. According to this indicator, systemic banking crises are a rare event in our country sample. They predominantly occur around the year 2008 and, thus, are highly correlated across countries.

Figures 4 to 6 show the corresponding effects of systemic banking crises on fiscal aggregates and on the composition of public finances. In contrast to our baseline results in Section 4, IRs are mostly statistically insignificant even for short forecast horizons. This is not unexpected as time dummies absorb a substantial portion of the variation in the Laeven and Valencia (2013) indicator.

Effects on expenditure-to-GDP and budget balance in GDP ratios are qualitatively similar to those shown in Figure 1. Systemic banking crises are also paired with an increase in the debt-to-GDP ratio. However, compared to Figure 1, the impact is muted. And, the impact of systemic banking crises on the tax-to-GDP ratio is only temporary and fads out after three years.

Although time dummies absorb most of the variation in the Laeven and Valencia (2013) indicator, the shift to expenditures on social security in the wake of a financial crisis is clearly visible even with this indicator. Yet, in contrast to Figure 2, no changes in the composition of tax revenues in the aftermath of systemic banking crises are discernible. Thus, using the alternative definition of financial distress advanced by Laeven and Valencia (2013), confirms that financial crises exert a lasting effect on the composition of public expenditures.

5.2 Estimation in Levels

According to unit root tests the variables used in this study are integrated of different orders (I(0) and I(1)). Hence, we use first differences of the variables integrated of order one in our baseline regressions. Yet, unit root tests may suffer from low power and differencing of variables removes potentially valuable level-information from the analysis. To see if our results are affected by differencing the data, we also estimate IRs based on estimating equations which have all variables measured in levels (see Sims et al., 1990; Ramey, 2016, p. 87 on this approach).

Specifically, we derive IRFs by running regressions for each forecast horizon h using the following specification:[11]

$$Fiscal_{it+h} = \sum_{n=1}^{3} \alpha_n^h Fiscal_{it-n} + \sum_{m=0}^{3} \beta_m^h FC_{it-m} + \sum_{n=1}^{3} \sum_{l=1}^{k} X'_{lit-n} \gamma_{nl}^h + \lambda_i^h + \kappa_t^h + \epsilon_{it+h}, \quad (2)$$

Figures 7 to 9 show that findings for debt-to-GDP well as for public expenditures ratios are in line with our baseline results, and, thus, support our prior findings of high fiscal costs and a deterioration of the quality of public expenditures.

The IRF for tax revenues contained in Figure 8 suggests that financial distress does not alter tax-to-GDP ratios compared to the counterfactual situation of no financial distress. While this result is in marked contrast to our baseline findings, which indicate a short- and medium-run fall in the tax-to-GDP ratio, the levels-regressions qualitatively support the shift in tax revenues from direct to indirect taxes (cf. Figure 8). Yet, IRs fall short of statistical significance in the short- as well as the medium-run.

5.3 Country-Specific Time Trends

Our final robustness check substitutes time dummies by country-specific time trends in Equation 1. Figures 10 to 12 contain the results. The 90-percent confidence intervals are generally somewhat smaller with country-specific trends, which may indicate that trends do not purge common shocks from the estimation of $\hat{\beta}_0^h$. Nevertheless, IRs are still of a similar order of magnitude. As shown by Figure 10, for fiscal aggregates we obtain similar IRFs when compared to Figure 1. The exception is that the response of the tax-to-GDP ratio is less persistent with country-specific trends.

For the impact of financial distress on the expenditure structure country-specific time trends paint a similar picture to time dummies. Financial distress leads to an increasing share of social security expenditures in total expenditures and a decrease in investment

[11] Note that although the expenditure and revenue shares in levels add up to unity, we do not apply a system estimator of the seemingly unrelated (SUR) type. The Jordá (2005) approach leads to serially correlated ϵ_{it} per construction. Applying plain SUR is not sufficient for valid inference. To the best of our knowledge, no estimator is available which corrects for both, MA(h)-type serial and contemporaneous correlation in ϵ_{it}.

expenditures. Yet, with trends, the impact on the share of interest payments fads out over time.

Concerning the revenue structure, we again see a shift towards revenues from indirect taxes. However, while with time dummies this shift comes at the cost of the share of long-run economic growth deterring direct taxes, it is revenues from growth-friendly property taxes which compensate in the medium-run in case of country-specific time trends.

6 Size of Financial Sector

The literature review in section 2 implies that the impact of systemic banking crises on fiscal aggregates depends on the size of the financial sector. For instance, Schularick (2012) states that "financial crises take a heavier toll on public revenues when the size of the financial sector is large. Crises in more highly financialised economies tend to have more severe effects on the revenue base and therefore go hand in hand with much costlier post-crisis stabilisation efforts." (p. 883) This section investigates whether the effect of financial distress on the composition of public finances, too, differs between countries with above and below average financial sectors. Given findings of prior studies and our discussion in Section 1, we expect compositional effects to be more prominent in highly financialized economies.

We follow Schularick (2012) and measure the size of the financial sector by the outstanding amount of credit granted by deposit money banks and other financial institutions to the private sector, measured relative to GDP.[12] A country is considered to have an above average financial sector in a given year if its outstanding private credit is larger than average outstanding private credit over all countries in this year. We create dummy variable $Size_{it}$ with entry one in case of an above average financial sector and zero otherwise.

We augment Equation 1 and run regressions for each forecast horizon h using the

[12]Variable $pcrdbofgdp$ of Cihak et al. (2012) which is equal to our control variable $privcredit_{it}$.

following specification:

$$Fiscal_{it+h} - Fiscal_{it} = \sum_{n=1}^{2} \alpha_n^h \Delta\ Fiscal_{it-n} + \sum_{m=0}^{2} \beta_m^h FC_{it-m} + \sum_{m=0}^{2} \zeta_m^h Size_{it-m-1} * FC_{it-m} + \sum_{l=1}^{k} X'_{lit-1}\gamma_l^h + \lambda_i^h + \kappa_t^h + \epsilon_{it+h}, \tag{3}$$

where X'_{lit-1} now additionally contains $\sum_{m=0}^{2} Size_{it-m-1}$ but excludes $privcredit_{it-1}$. Special interest lies in sign and significance of coefficient ζ_0^h. A statistically significant ζ_0^h indicates that financial distress has a stronger impact on fiscal variables in countries with an above average financial sector.

Table 7 shows ζ_0^h as well its statistical significance for those cases we are able to uncover differences in the effects financial distress has on fiscal variables in countries with above and below average financial sectors.

The second column of Table 7 shows that financial distress increases the debt-to-GDP ratio especially in countries with large financial sectors, a finding which is already unveiled by Schularick (2012) and Tagkalakis (2013). In addition, consistent with Schularick (2012), the tax-to-GDP ratio falls significantly stronger in relatively highly financialized economies.

Turning to the composition of public finances, we see that social security and interest expenditures rise more strongly in countries with above average financial sectors. In turn, the fall in public investment expenditures is more pronounced in these countries in the medium-run.

For the composition of tax revenues, an interesting results emerges with respect to the share of indirect taxes. Findings indicate that the increase in the importance of indirect taxes is larger in countries with relatively small financial sectors. Moreover, it is less financialized countries which reduce the importance of social security contributions while they may even gain in importance in highly financialized economies (cf. Column 6 of Table 7).

7 Summary and Concluding Remarks

What can we conclude regarding the impacts of financial distress on fiscal aggregates and compositions? With respect to debt-to-GDP ratios our analysis confirms prior studies which suggest high fiscal costs of financial distress in form of strongly increasing debt-to-GDP ratios. These fiscal costs of financial distress are especially high in highly financialized economies.

Tax revenues as well as public expenditures in GDP also strongly react to financial distress. While the effect of financial distress on expenditure-to-GDP ratios is only temporary, in countries with above average financial sectors the effect on tax-to-GDP ratios lasts over the medium-run.

Regarding compositional effects of financial crises, we find a shift of public expenditures to social security expenditures not only in the short- but also in the medium-run. At the same time the share of public investment expenditures falls. In addition, our results are also consistent within an increasing importance of interest payments in total expenditures. Again, these effects are especially pronounced in countries with above average financial sectors.

From these results we conclude that financial distress not only leads to high fiscal costs in form of strongly increasing debt-to-GDP ratios, but also to a deterioration of the quality of public expenditures. From an economic perspective this shift towards welfare state expenditures and away from directly productivity enhancing public investment expenditures may be detrimental to a country's longer-run growth performance (see, e.g., Gemmell et al., 2016).

On the revenue side, our results indicate a shift to tax revenues from indirect taxes. Once we allow for different effects in countries with above and below average financial sectors, we see that the shift to indirect taxes initially is more pronounced in countries with relatively small financial sectors. Put differently, economies hit hardest by financial distress do not shift tax burden to a larger extent to growth-friendly indirect taxes. In addition, only in less financialized economies the share of less economic growth-friendly social security contributions decreases in the wake of financial distress. We interpret these results as indication that governments do not use financial crises as a "window of

opportunity" to improve the quality of tax structures. Thus, our findings are consistent with the view that financial crises do not beget long-run growth-friendly reform of tax structures.

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Table 1: Financial Distress: Years and severity

Country	Year	FC_{it}	Country	Year	FC_{it}	Country	Year	FC_{it}
Australia	2008	4	Iceland	2009	14	New Zealand	2012	1
Australia	2009	1	Iceland	2010	7	Norway	1991	9
Austria	2008	7	Iceland	2011	7	Norway	1992	8
Austria	2009	7	Iceland	2012	2	Norway	1993	6
Austria	2010	4	Ireland	2008	6	Norway	1994	2
Austria	2011	3	Ireland	2009	7	Norway	2007	1
Austria	2012	5	Ireland	2010	8	Norway	2008	7
Belgium	2008	4	Ireland	2011	8	Norway	2009	9
Belgium	2009	3	Ireland	2012	6	Portugal	2008	7
Belgium	2011	2	Italy	1997	1	Portugal	2009	8
Canada	2008	5	Italy	2008	7	Portugal	2010	9
Canada	2009	5	Italy	2009	6	Portugal	2011	8
Denmark	2008	6	Italy	2010	6	Portugal	2012	8
Denmark	2009	7	Italy	2011	5	Spain	2008	7
Denmark	2010	3	Italy	2012	8	Spain	2009	6
Denmark	2011	3	Japan	1990	3	Spain	2010	5
Denmark	2012	2	Japan	1991	5	Spain	2011	7
Finland	1992	6	Japan	1992	4	Spain	2012	8
Finland	1993	8	Japan	1993	5	Sweden	1992	5
Finland	1994	3	Japan	1994	3	Sweden	1993	8
Finland	2008	4	Japan	1995	5	Sweden	2008	7
Finland	2009	4	Japan	1996	6	Sweden	2009	5
France	1991	1	Japan	1997	7	Sweden	2010	3
France	1995	4	Japan	1998	13	Switzerland	2008	4
France	1996	5	Japan	1999	9	Switzerland	2009	1
France	1997	3	Japan	2000	4	Switzerland	2012	1
France	2008	7	Japan	2001	6	United Kingdom	2008	10
France	2009	6	Japan	2002	8	United Kingdom	2009	9
France	2010	3	Japan	2003	6	United Kingdom	2010	5
France	2011	5	Japan	2004	4	United Kingdom	2011	3
France	2012	4	Japan	2005	2	United Kingdom	2012	3
Germany	1974	2	Japan	2008	3	United States	1986	1
Germany	2003	1	Japan	2009	4	United States	1990	8
Germany	2008	6	Japan	2010	1	United States	1991	4
Germany	2009	5	Luxembourg	2008	5	United States	1992	2
Germany	2010	4	Luxembourg	2009	3	United States	1998	3
Germany	2011	3	Luxembourg	2010	1	United States	2007	1
Germany	2012	2	Luxembourg	2011	2	United States	2008	14
Greece	2008	4	Netherlands	2008	3	United States	2009	10
Greece	2009	7	Netherlands	2009	4	United States	2010	6
Greece	2010	8	Netherlands	2011	1	United States	2011	2
Greece	2011	7	Netherlands	2012	4	United States	2012	1
Greece	2012	8	New Zealand	2008	6			
Iceland	2006	5	New Zealand	2009	6			
Iceland	2007	2	New Zealand	2010	1			
Iceland	2008	11	New Zealand	2011	3			

Source: Romer and Romer (2016).

Table 2: Data Description: Financial Crises and Control Variables

Variable	Definition	Data Sources	MEAN	StD	MIN	MAX
FC_{it} (Romer and Romer, 2016)	Indicator for occurrence and severity of financial crisis	Romer and Romer (2016)	0.71	2.02	0	14
FC_{it} (Laeven and Valencia, 2013)	Indicator for occurrence of systemic banking crisis	Laeven and Valencia (2013)	0.02	0.15	0	1
$growth_{it-1}$	Rate real economic growth	OECD Economic Outlook database	2.49	2.70	-8.87	26.29
$infl_{it-1}$	CPI inflation rate	OECD Economic Outlook database	4.99	6.91	-18.44	84.72
kof_{it-1}	Economic globalization	Dreher (2006)	70.77	15.34	33.48	99.00
$privcredit_{it-1}$	Share of private credit by deposit money banks and other financial institutions in GDP	Beck et al. (2009), Cihak et al. (2012)	76.04	41.11	9.66	262.46
$popshare_{it-1}$	Share of population aged 15 to 64 in total population	OECD Economic Outlook database	65.77	2.19	57.70	69.89
$Size_{it}$	Dummy variable indicating country-years with above average financial sector	Same as $privcredit_{it-1}$	0.47	0.49	0.00	1.00

Table 3: Data Description: Fiscal Variables

OECD classification	MEAN	StD	MIN	MAX
1000 (Share of direct tax revenues in total tax revenues)	38.15	11.87	11.82	69.99
2000 (Share of social security contributions in total tax revenues)	23.71	12.61	0.00	50.19
4000 (Share of property tax revenues in total tax revenues)	6.10	3.29	0.83	21.42
5000 (Share of indirect tax revenues in total tax revenues)	30.34	8.10	12.34	62.98
3000 + 6000 (Share of taxes from payroll and workforce as well as "other taxes")	1.60	2.36	0.00	10.75
SSPG (Share of social expenditures in total expenditures)	27.64	5.47	11.88	40.03
IGAA (Share of public investment expenditures in total expenditures)	8.75	3.06	3.62	22.40
CGAA (Share of public consumption expenditures in total expenditures)	42.23	4.71	29.94	55.73
GGINTP (Share of interest payments in total expenditures)	7.35	4.46	0.49	22.32
YPOTG + YPEPG - GGINTP (Share of other current expenditures and property income paid excluding interest payments)	14.03	4.09	7.14	29.82
Total expenditures in percent of GDP (excluding "Capital Transfers paid and other capital payments")	46.00	8.32	20.78	69.83
Total tax revenues in percent of GDP	33.97	7.19	15.50	49.58
Budget balance in percent of GDP	-2.29	4.53	-32.13	18.70
Gross debt in percent of GDP	67.89	36.77	7.85	233.68

Source: OECD National Accounts and Revenue Statistics databases.

Table 4: Systemic Banking Crisis

Country	Year(s)
Austria	2008
Belgium	2008
Denmark	2008
Germany	2008
Finland	1991
France	2008
Greece	2008
Iceland	1975, 2008
Ireland	2008
Italy	2008
Luxembourg	2008
Japan	1997
Netherlands	2008
Norway	1991
Portugal	2008
Spain	1977, 2008
Sweden	1991, 2008
Switzerland	2008
United Kingdom	2007
United States	1988, 2007

Start year of Systemic Banking Crisis according to Laeven and Valencia (2013).

Table 5: Size of Financial Sector and Composition of Public Finances

ζ_0^h	Variable						
h	Tax-to-GDP	Debt-to-GDP	SSPG	IGAA	GGINTP	2000	5000
8	-2.25***	4.97	1.39***	-2.22***	1.78***	2.05***	-0.35
7	-1.32**	12.46***	1.76***	-2.48***	2.15***	2.39***	-1.37
6	-1.25***	13.06***	1.54***	-2.08***	2.14***	2.19***	-1.65***
5	-1.78***	20.27***	1.64***	-2.21***	2.24***	2.03***	-1.38***
4	-0.68	20.66***	1.57***	-1.37***	1.69***	1.86***	-1.41***
3	-1.50***	16.74***	1.12***	-0.68	0.98***	1.73***	-1.08***
2	-1.70***	11.00***	0.83***	-0.59	0.74	1.25***	-1.08***
1	-1.19***	5.65***	0.47***	-0.15	0.05	1.29	0.02

β_0^h							
h	Tax-to-GDP	Debt-to-GDP	SSPG	IGAA	GGINTP	2000	5000
8	1.06	7.15	0.43	0.42	-0.70	-1.64*	1.78***
7	0.39	0.65	-0.26	0.90	-0.85	-2.01***	2.69***
6	0.11	2.16	-0.04	0.47	-0.92	-2.09***	3.25***
5	0.49	4.14	-0.04	0.58	-0.83	-2.11***	2.92***
4	-0.17	3.42	0.33	-0.31	-0.34	-1.74***	2.40***
3	0.09	2.72	0.62	-0.73	0.05	-1.10***	2.12***
2	0.51	0.35	0.38	-0.33	0.44	-0.46	1.64***
1	0.41	1.39	0.18	-0.26	0.29	-0.07	0.45

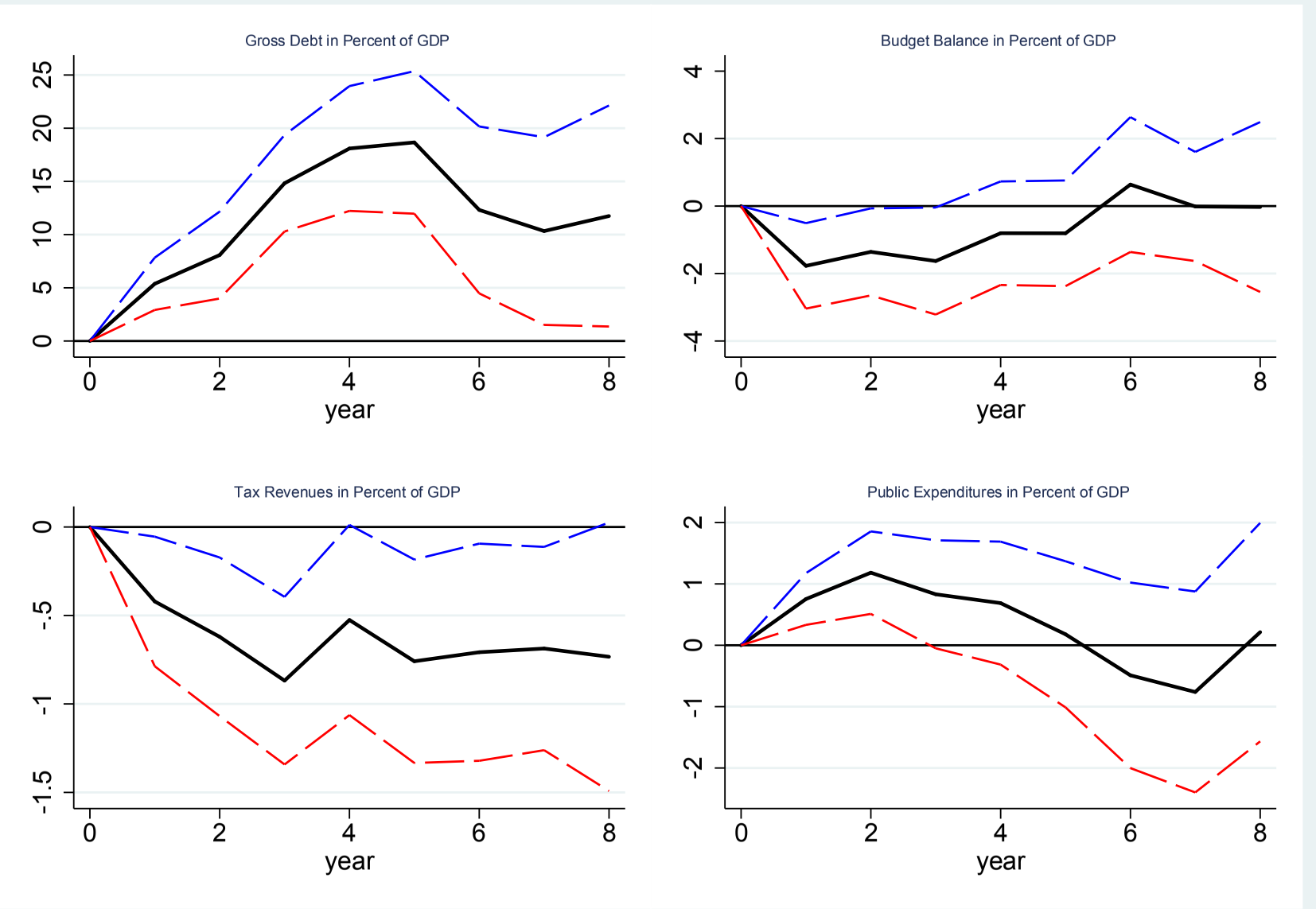
SSPG = Share of Social Security Expenditures in Total expenditures;

IGAA = Share of Investment Expenditures; GGINTP = Share of interest payments;

2000 = Share of Social Security Contributions in Total Tax Revenues; 6000 = Share of Indirect Taxes;

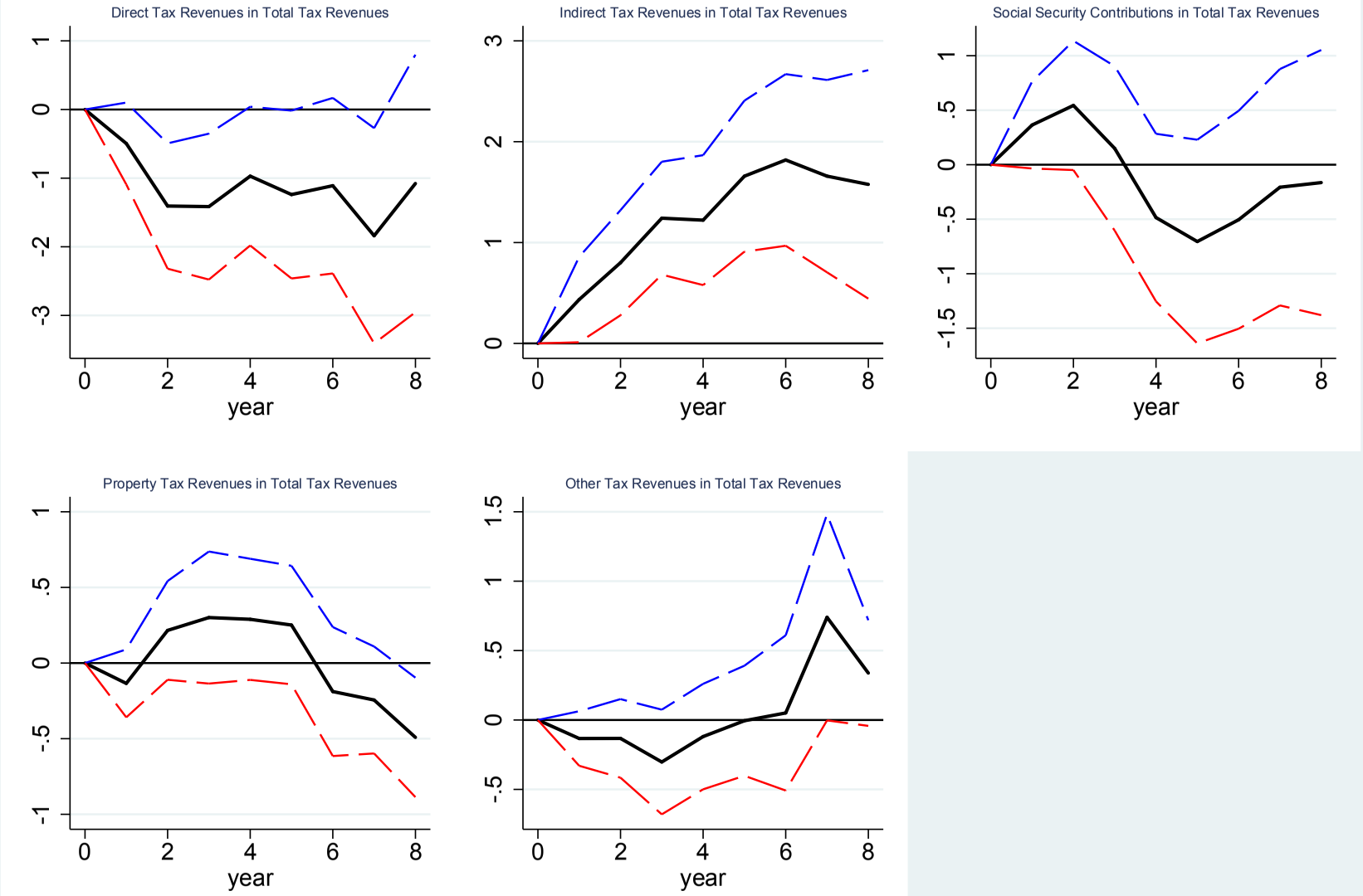
Based on Equation (3) with time dummies; *** / * = significant at 1- and 10-percent level.

Figure 1: Fiscal Aggregates



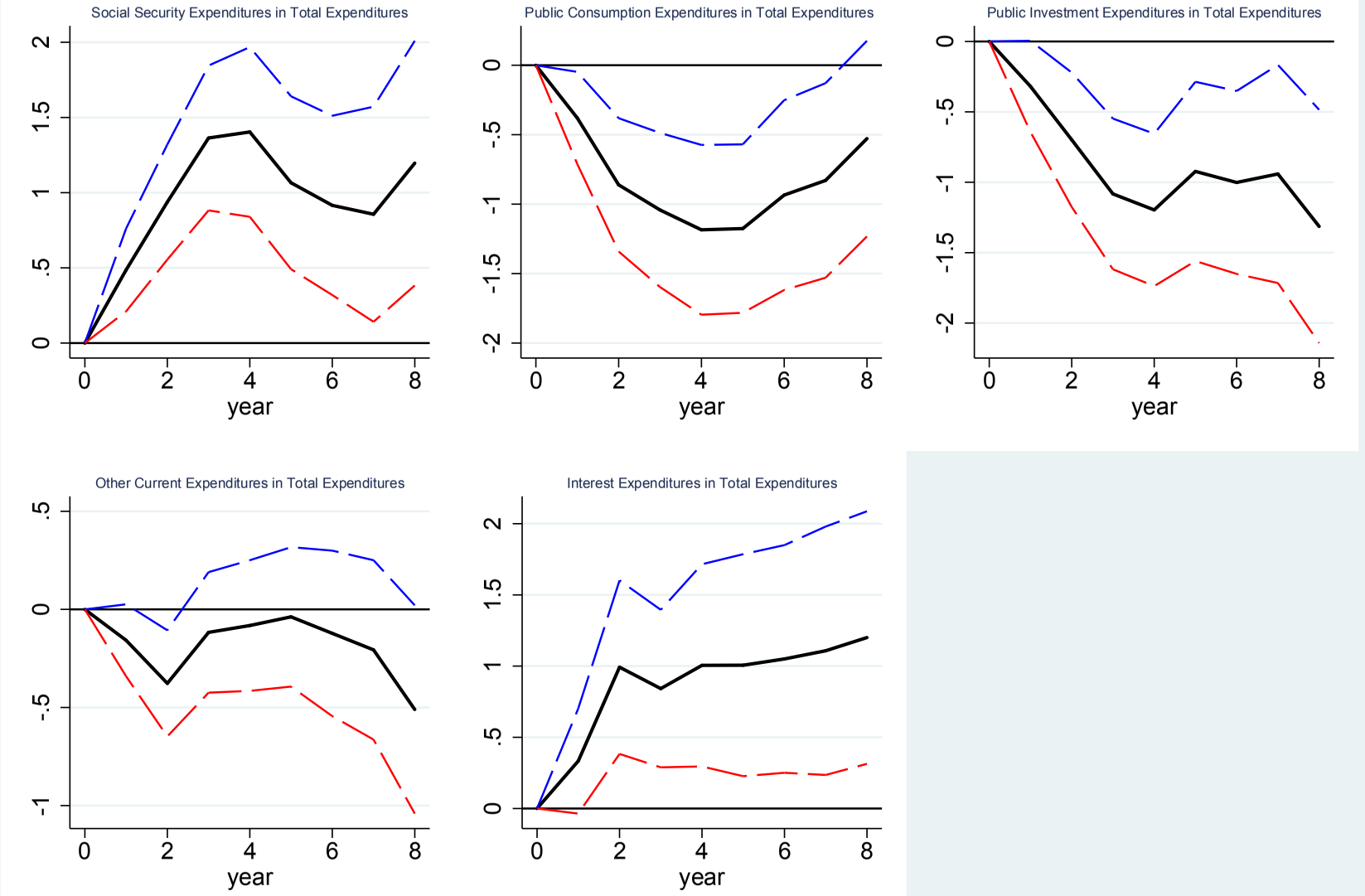
Notes: Solid lines denote IRs; dashed lines signify 90-percent confidence bands; based on Equation (1) with time dummies

Figure 2: Taxes in Total Tax Revenues



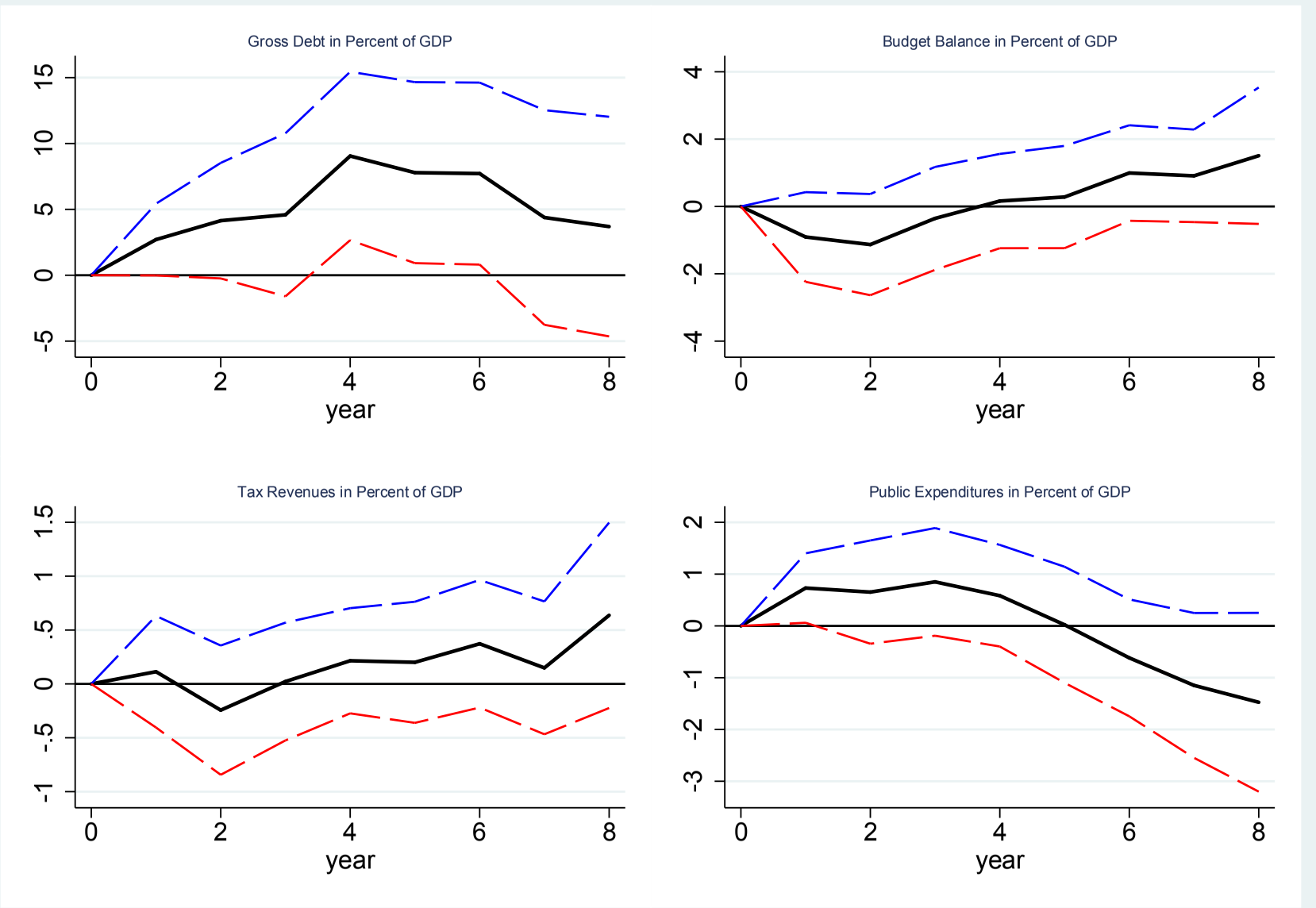
Notes: Solid lines denote IRs; dashed lines signify 90-percent confidence bands; based on Equation (1) with time dummies

Figure 3: Expenditures in Total Expenditures



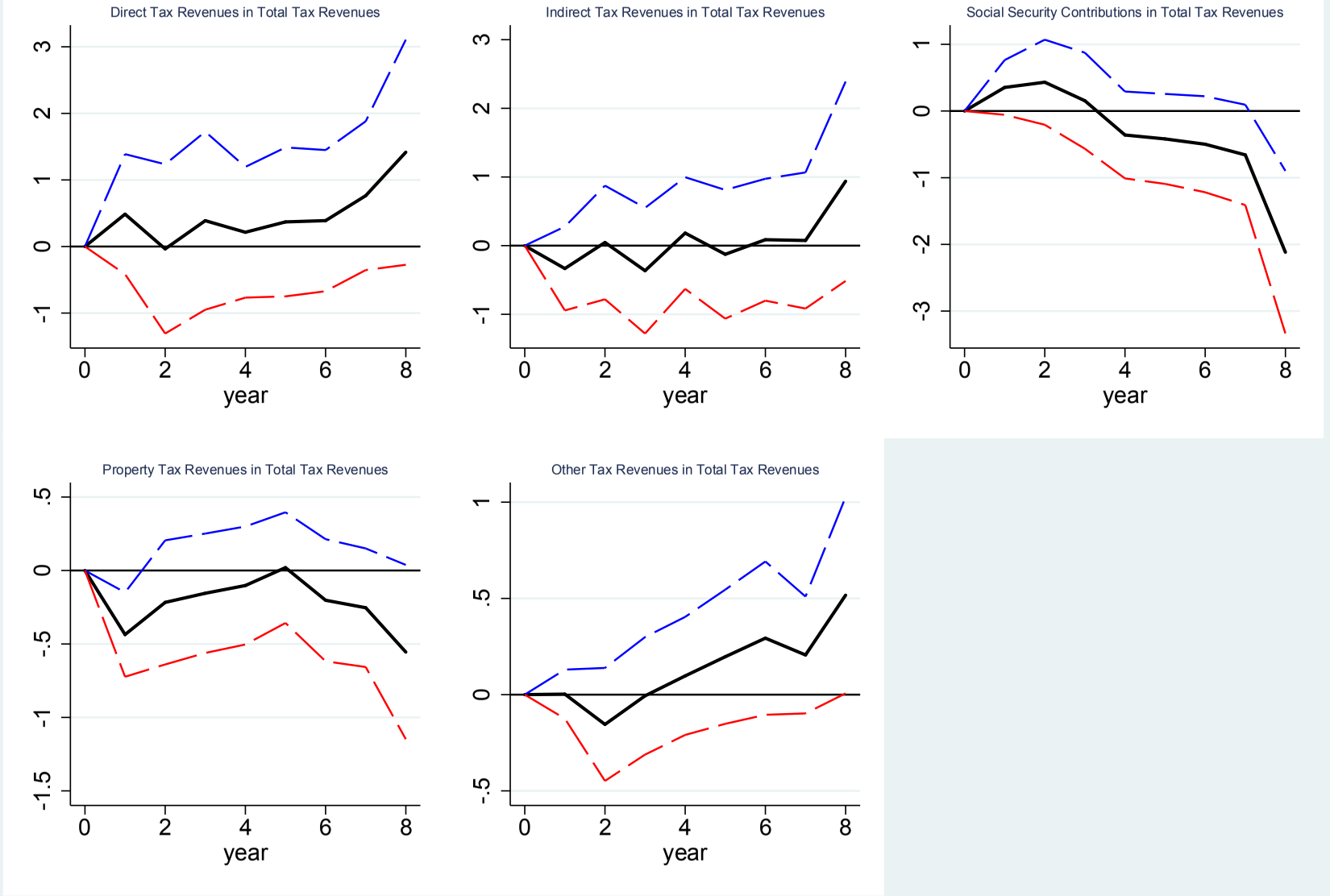
Notes: Solid lines denote IRs; dashed lines signify 90-percent confidence bands; based on Equation (1) with time dummies

Figure 4: Systemic Banking Crisis: Fiscal Aggregates



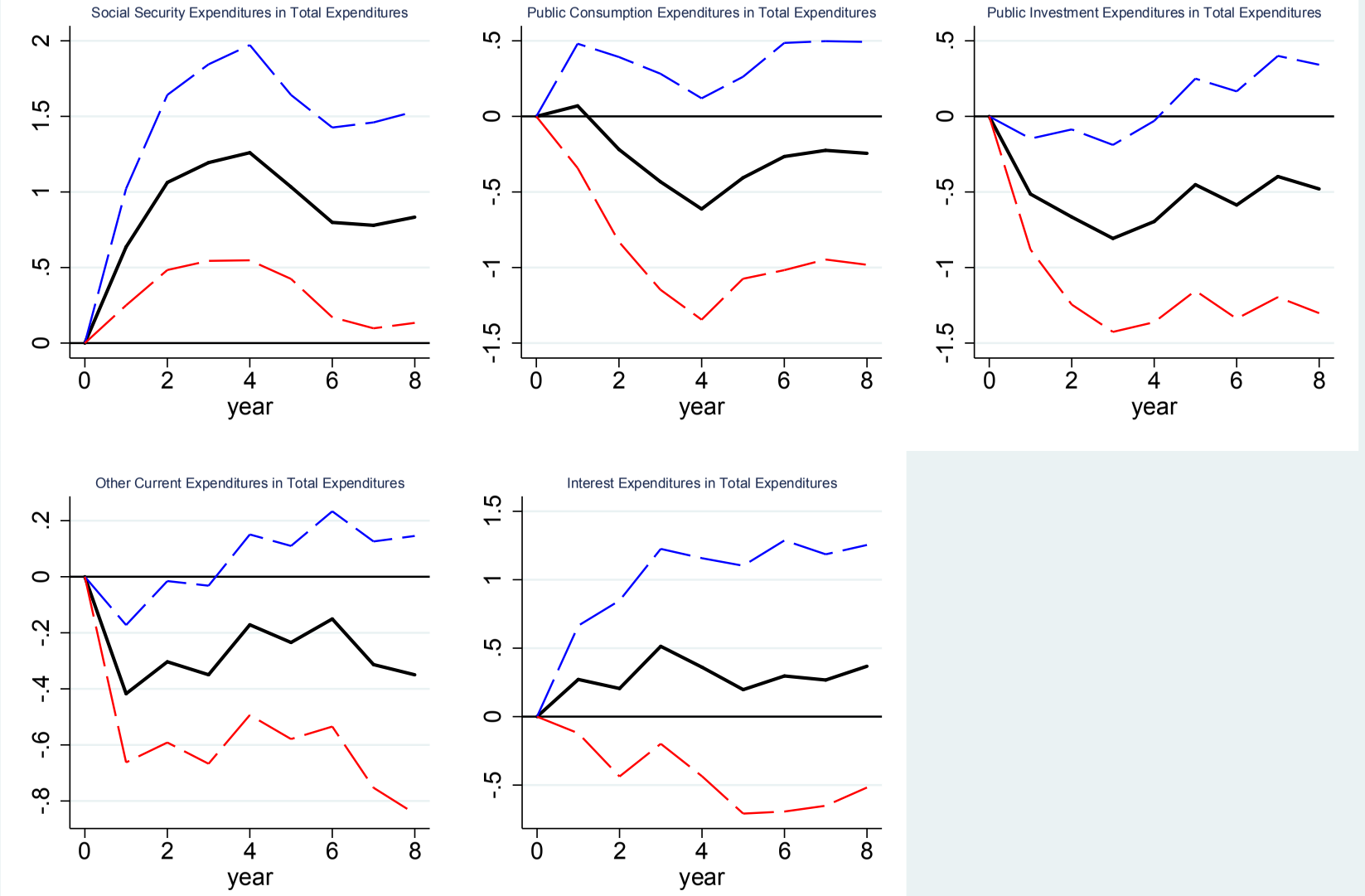
Notes: Solid lines denote IRs; dashed lines signify 90-percent confidence bands; based on Equation (1) with time dummies

Figure 5: Systemic Banking Crisis: Taxes



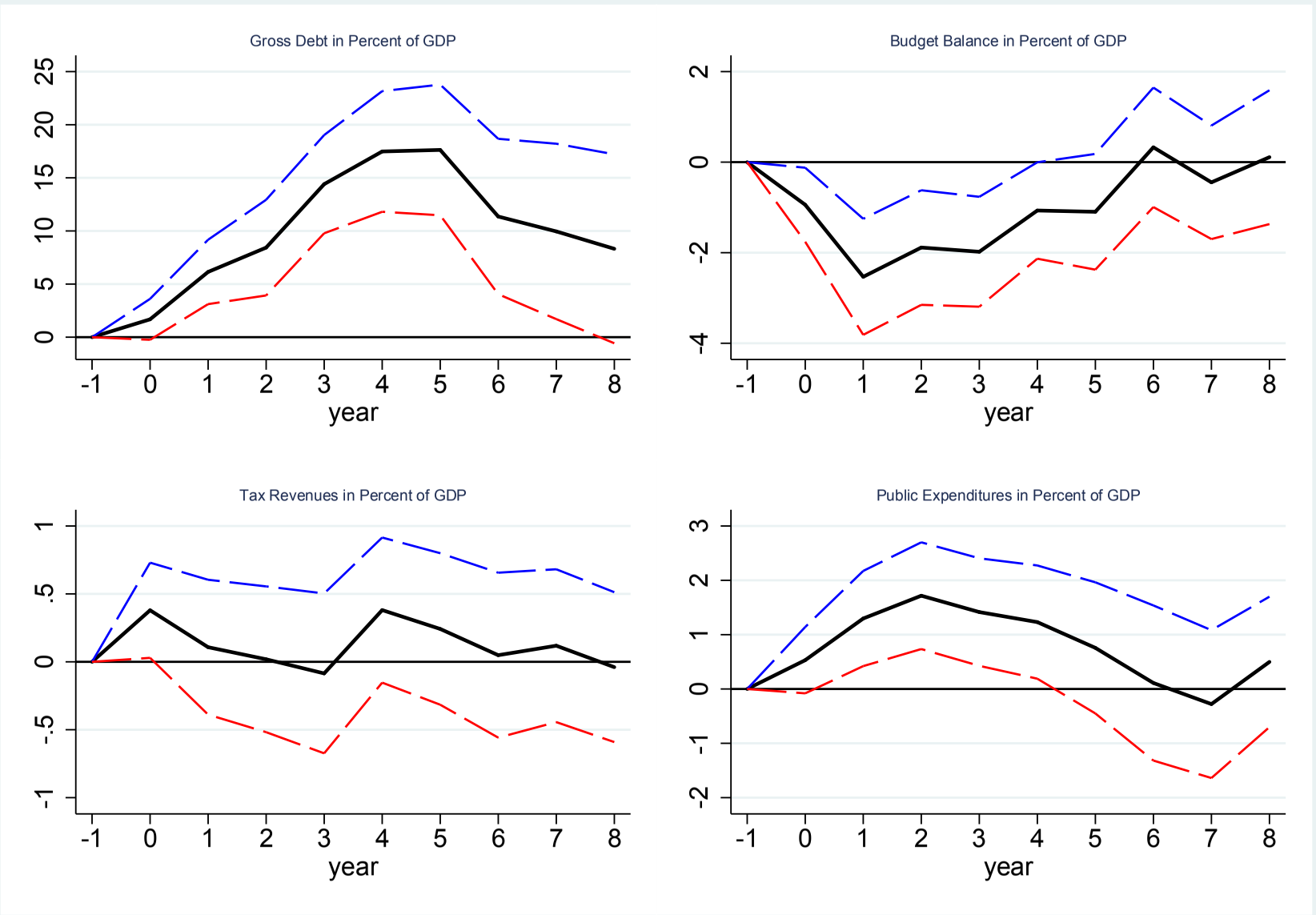
Notes: Solid lines denote IRs; dashed lines signify 90-percent confidence bands; based on Equation (1) with time dummies

Figure 6: Systemic Banking Crisis: Expenditures



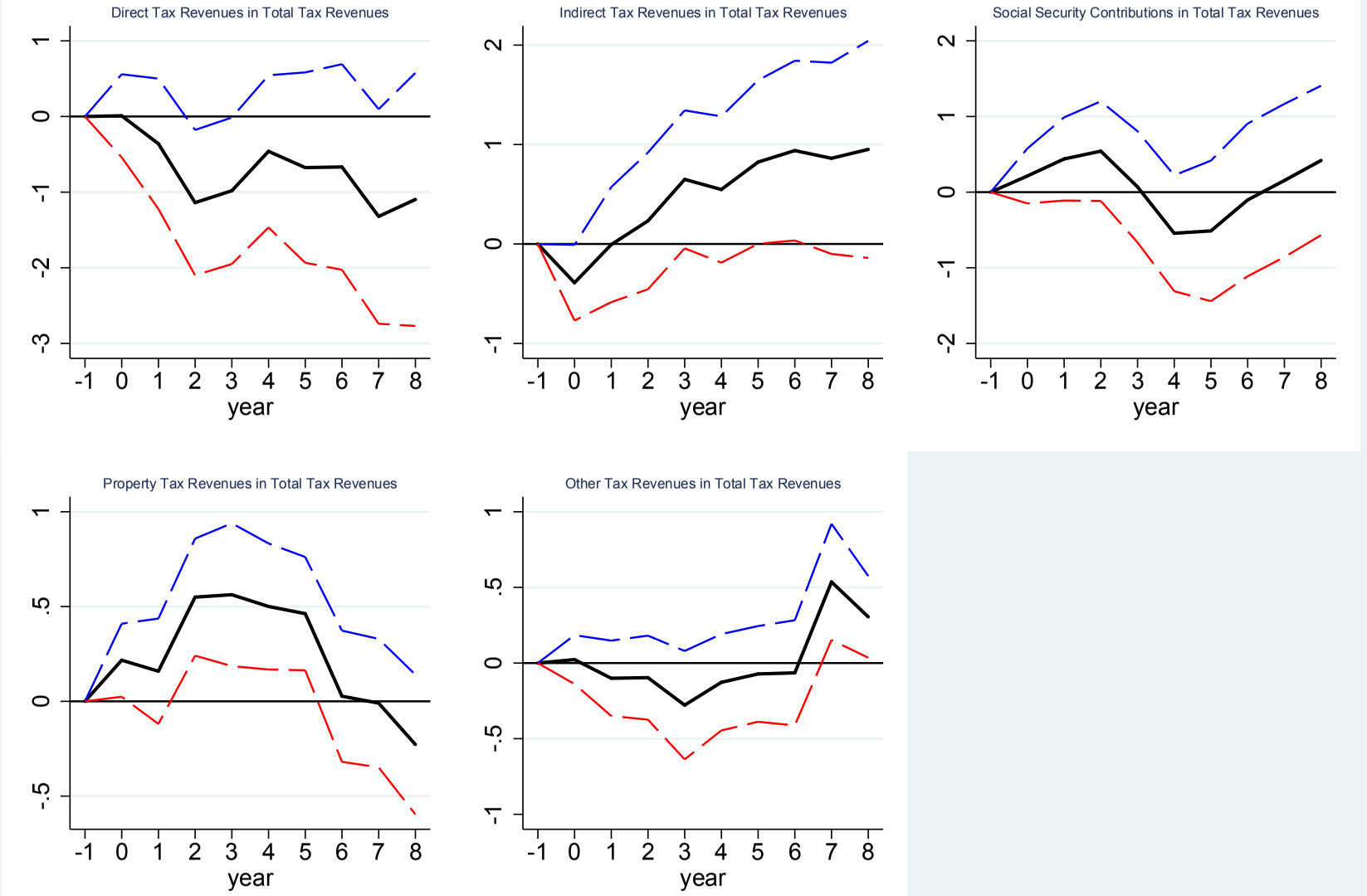
Notes: Solid lines denote IRs; dashed lines signify 90-percent confidence bands; based on Equation (1) with time dummies

Figure 7: Levels Equation: Fiscal Aggregates



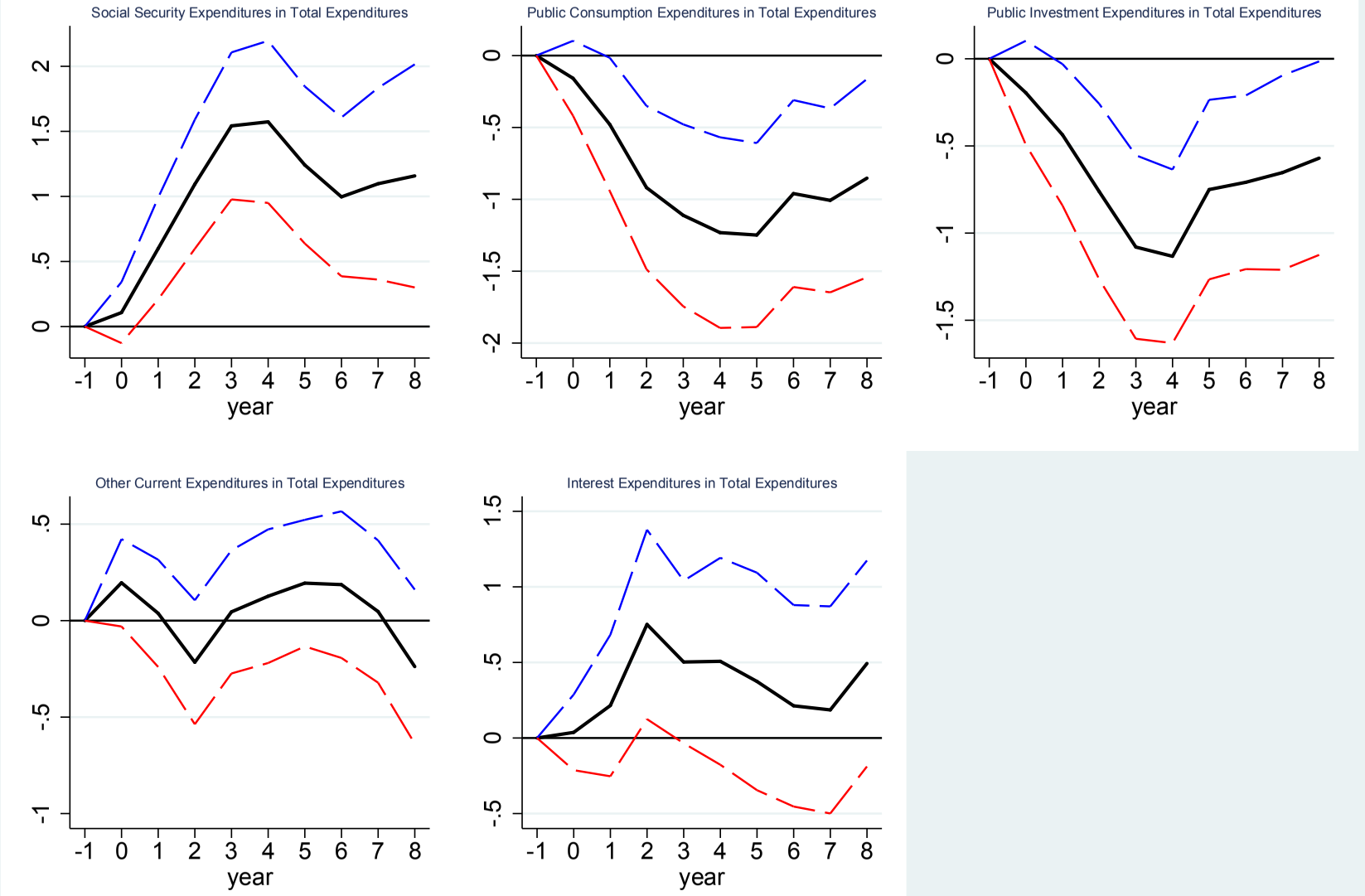
Notes: Solid lines denote IRs; dashed lines signify 90-percent confidence bands; based on Equation (2) with time dummies

Figure 8: Levels Equation: Taxes



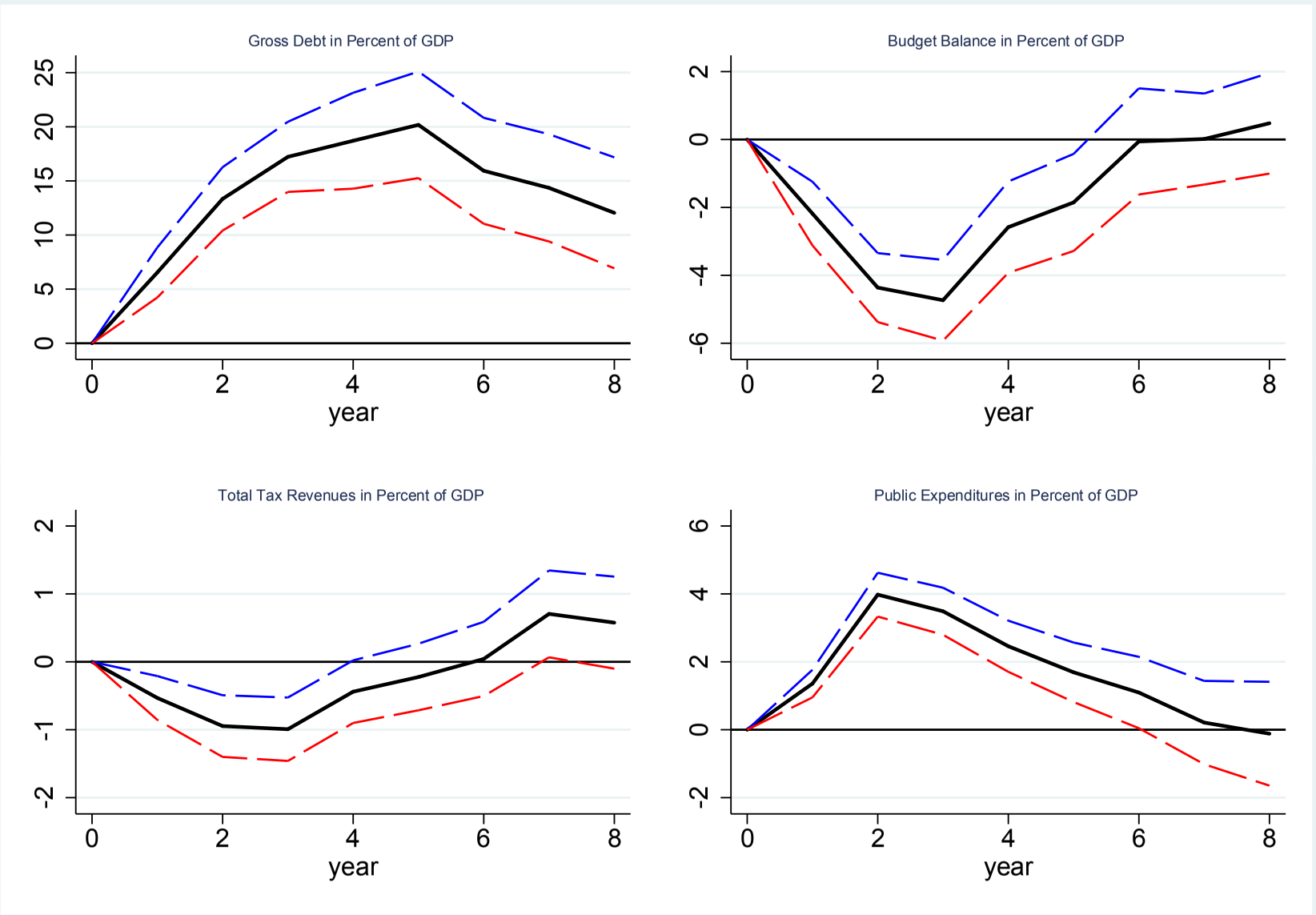
Notes: Solid lines denote IRs; dashed lines signify 90-percent confidence bands; based on Equation (2) with time dummies

Figure 9: Levels Equation: Expenditures



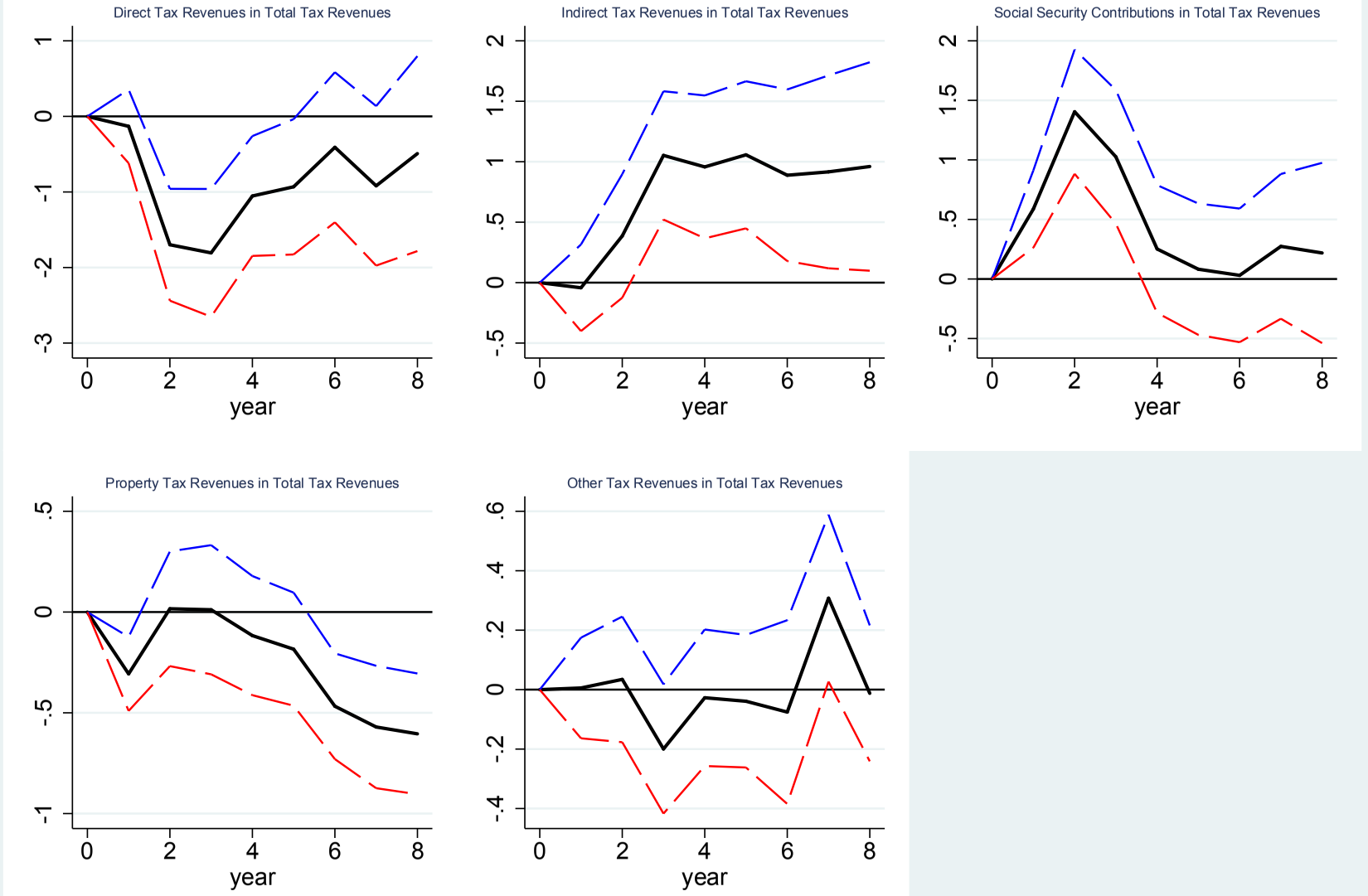
Notes: Solid lines denote IRs; dashed lines signify 90-percent confidence bands; based on Equation (2) with time dummies

Figure 10: Trends: Fiscal Aggregates



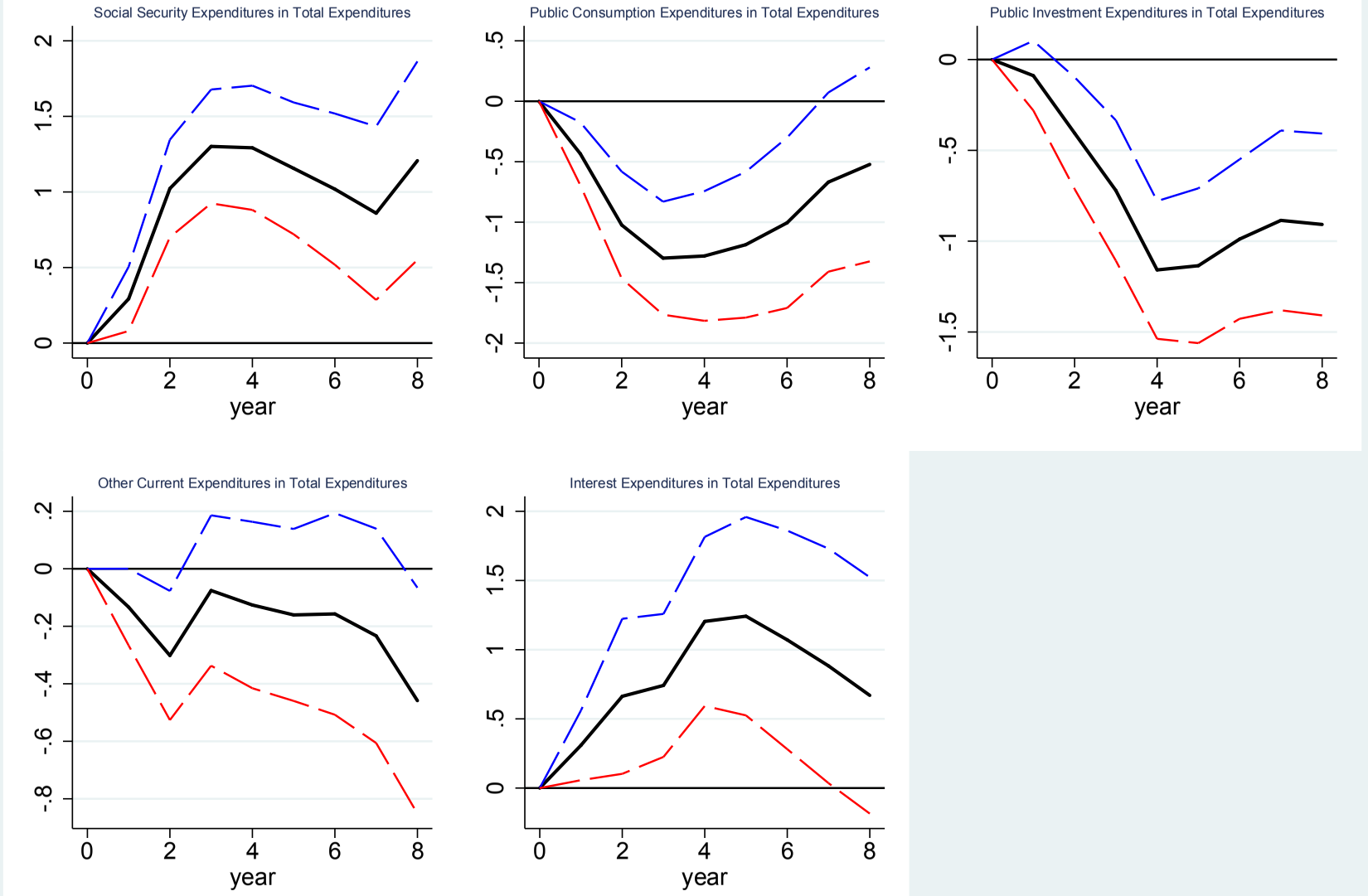
Notes: Solid lines denote IRs; dashed lines signify 90-percent confidence bands; based on Equation (1) with time trends

Figure 11: Trends: Taxes



Notes: Solid lines denote IRs; dashed lines signify 90-percent confidence bands; based on Equation (1) with time trends

Figure 12: Trends: Expenditures



Notes: Solid lines denote IRs; dashed lines signify 90-percent confidence bands; based on Equation (1) with time trends