



Does sovereign debt weaken economic growth? A panel VAR analysis



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HIGHLIGHTS

- We estimate a PVAR model to analyze the relationship between debt and growth.
- We find that an increase in growth has a negative effect on debt.
- We find no evidence for a significant long-run reverse impact of debt on growth.

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ABSTRACT

We estimate panel vector autoregressions to analyze the highly disputed relationship between sovereign debt and economic growth. Using data on 20 developed countries, we find no evidence for a robust effect of debt on growth, even for higher levels of debt. We do find a significant negative reverse effect of growth on debt, which explains the negative correlation.

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1. Introduction

In an influential article, Reinhart and Rogoff (2010) argue that countries face a dramatic decline in their growth potential when their debt-to-GDP ratio reaches 90 percent.¹ Herndon et al. (2013) uncover a number of computational errors in the results of Reinhart and Rogoff (2010) and challenge the robustness of a '90 percent threshold'. It is also unclear whether correlation implies causation. Does high debt lead to low growth, or does low growth lead to high debt?

In an attempt to decompose cause and effect, we estimate panel vector autoregressions (PVAR) that describe the dynamic relation between sovereign debt and economic growth, using data on debt and GDP for a panel of 20 developed countries ranging from the beginning of the 20th century. Following the contribution by Holtz-Eakin et al. (1988), PVARs have become a standard tool for

analyzing multivariate time-series in a panel context. One of the strengths of PVARs is that multiple variables, in our case debt and GDP, can be simultaneously treated as endogenous. This allows us to estimate both the effect of debt on growth, as well as the reverse effect of growth on debt. We find that the negative correlation between the variables is primarily driven by the impact of growth on debt rather than *vice versa*.

2. Data and methodology

From the dataset of Reinhart and Rogoff (2009) we obtain data on gross government debt. Data on real GDP per capita come from the Maddison database of the Groningen Growth and Development Centre. Our dataset comprises annual data on 20 and 10 developed countries, over the periods 1954–2008 and 1905–2008, respectively. These countries are listed in Table 1.

To analyze the dynamic relationship between debt and GDP, we compute the impulse-response functions from an estimated PVAR. Using the growth rates (log-differences) of real GDP per capita (ΔY) and the growth rate of total gross government debt per capita (ΔD) as our variables of interest, we estimate the following PVAR:

$$y_{it} = \mu_i + \Lambda y_{it-1} + \varepsilon_{it}, \quad (1)$$

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¹ See also Baum et al. (2013).

Table 1
Country list.

Country	1954–2008	1905–2008	av. debt >50%	max. debt >90%
Australia	x	x	–	–
Austria	x	–	–	–
Belgium	x	–	x	x
Canada	x	x	x	–
Denmark	x	x	–	–
Finland	x	x	–	–
France	x	–	–	–
Germany	x	–	–	–
Greece	x	–	x	x
Ireland	x	–	x	x
Italy	x	x	x	x
Japan	x	–	x	x
Netherlands	x	–	x	x
New Zealand	x	x	–	–
Norway	x	–	–	–
Portugal	x	x	–	–
Spain	x	–	–	–
Sweden	x	x	–	–
UK	x	x	x	x
USA	x	x	x	–

Notes: first column marks the countries for which time-series for 1954–2008 are available ($N = 20, T = 55$). Second column marks the countries for which time-series for 1905–2008 are available ($N = 10, T = 104$). Third column marks the countries for which the average debt-to-GDP ratio during the period 1954–2008 exceeds 50% ($N = 9$). Fourth column marks the countries for which the maximum debt-to-GDP ratio during the period 1954–2008 exceeds 90% ($N = 7$).

in which $y_{it} = (\Delta D_{it}, \Delta Y_{it})'$, μ_i is a 2×1 country-specific intercept term (fixed effect), A is a 2×2 coefficient matrix and ε_{it} is a 2×1 residual term. The subscripts i and t denote country and year, respectively. The VAR includes only first-order lags, which is selected using the Bayesian Information Criterion.

We estimate the PVAR using the fixed-effects (FE) estimator.² Besides the fixed effects, the coefficient matrix A , and the covariance matrix of the residuals are assumed homogeneous across countries. Under this assumption, the pooled estimates of A can be used to compute the impulse-response functions. Confidence intervals for the impulse-response functions are computed by bootstrap simulation, see Lof et al. (2013) for details.

To identify the shocks, we impose a recursive structure, which makes the order of the variables relevant. We follow Caldara and Kamps (2008), who note that because of the delay between political decision making and actual government spending, fiscal policy may have an instantaneous effect on GDP, while the reverse effect can only occur after a lag. We therefore place debt before GDP. As a robustness check we consider the VAR in the reverse recursive order and find that the imposed order has no substantial effect on the results.

3. Results

Fig. 1 depicts the impulse-response functions derived from the estimated VAR (Eq. (1)). The figure shows the impact on debt (left column) and GDP (right column) for a period of ten years after a positive shock to either debt (top row) or GDP (bottom row). Both debt and GDP are measured in per capita terms and are transformed to growth rates by log-differencing. From the diagonal panels (top left and bottom right) it appears that shocks to both

growth rates of debt and GDP are transitory: the effects of a shock die out within a couple of years.

The off-diagonal panels show the impact on debt, after a shock to GDP (bottom-left) and the reverse impact on growth, after a shock to debt (top-right), which is of our main interest. The top-right impulse response shows no evidence for any significant effect of debt on GDP growth. A positive shock to GDP growth does however have a significant negative effect on debt (bottom left). Based on these figures, it seems the negative correlation between debt and GDP therefore results from the negative impact of GDP growth on debt, rather than the negative impact of debt on GDP growth.

The same results apply when we look at the levels instead of differences. Fig. 2 depicts the cumulative impulse response functions from the VAR. By cumulating the impact over time, these plots show the effect on the levels, rather than on the differences of debt and GDP (both in logs). Although the plots look different from Fig. 1, the interpretation is the same. A shock to debt has no significant impact on GDP (top-right). After a shock hits GDP, however, we can clearly see a negative impact on the level of debt (bottom-left).

In Fig. 3, we display the cumulative impulse response functions from four alternative PVAR specifications. Compared to Fig. 2, we display only the off-diagonal panels, showing the dynamic effects of debt on growth (top) and vice versa (bottom). First we consider the VAR with debt and GDP measured in aggregate terms, rather than per capita (Fig. 3(A)). For Fig. 3(B), we replace the level of debt with the debt-to-GDP ratio.³ Next, we consider the benchmark model with the recursive order reversed (Fig. 3(C)). Finally, in Fig. 3(D), we consider a subset of 10 countries (listed in Table 1), for which the VAR is estimated using a longer time-series that spans from 1905 to 2008.

Fig. 4 reproduces the off-diagonal panels of Fig. 2, for four different subsamples (listed in Table 1). Fig. 4(A) is produced using only the data on 9 high-debt countries, for which the average

² To avoid inconsistency of the FE estimator (Nickel, 1981), dynamic panel-models are often first-differenced to eliminate the fixed effect (See, e.g. Baltagi, 2008, Chapter 8). In our case, our sample size seems sufficiently large ($T = 55$), to apply the FE estimator. As a robustness check, we obtained GMM estimates of a first-differenced version of the model, with highly similar results (available upon request).

³ We also reverse the recursive order, because it is by construction impossible that a shock to GDP has no instantaneous impact on the debt-to-GDP ratio.

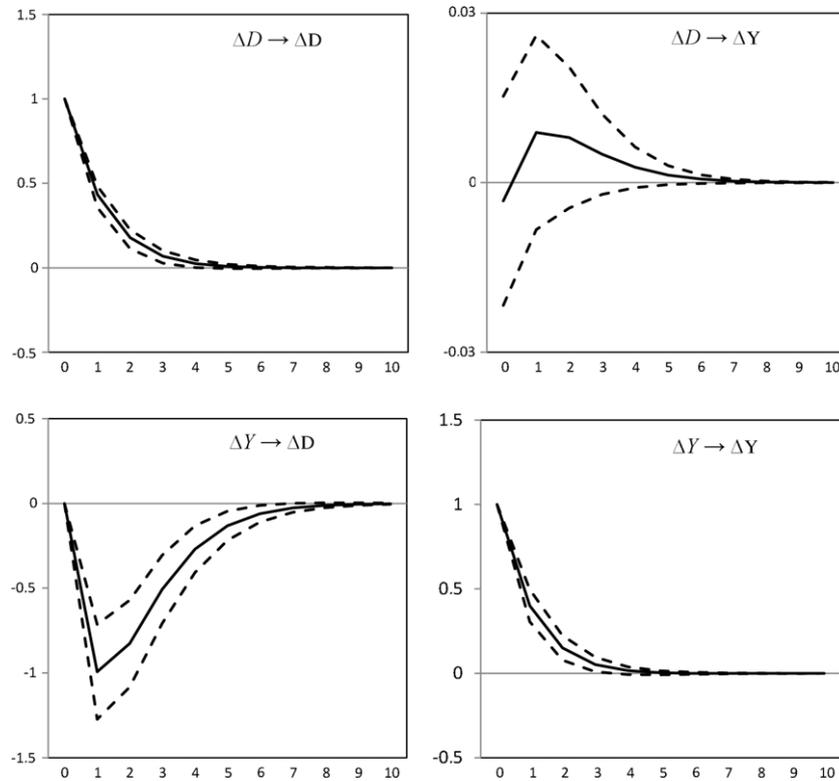


Fig. 1. Impulse-response functions computed from estimated PVAR (Eq. (1)), for 20 countries over the period 1954–2008. 95% confidence bounds are based on 10,000 bootstrap simulations.

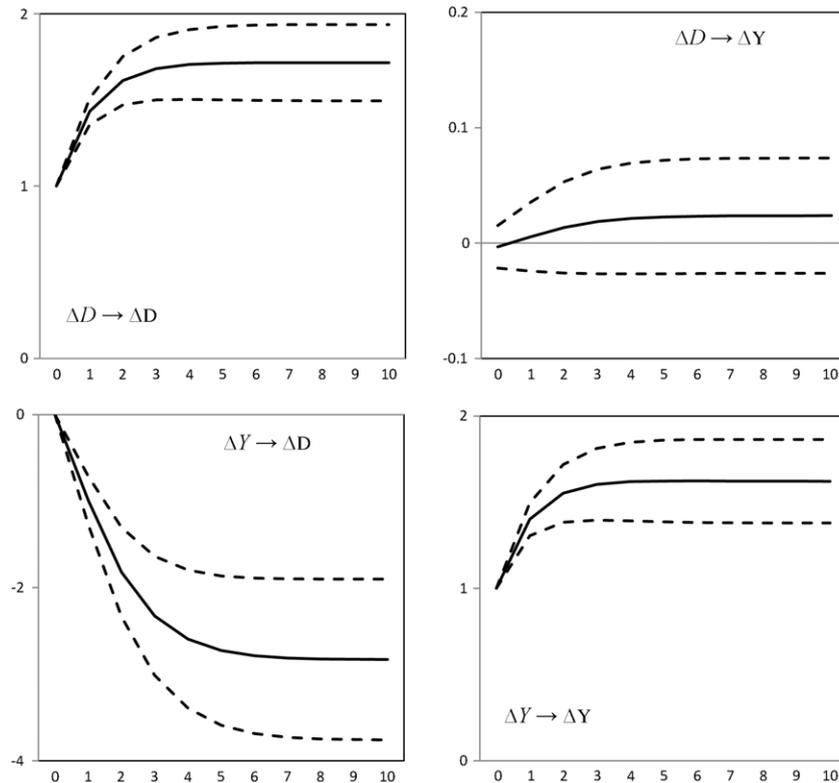


Fig. 2. Cumulative impulse-response functions. See Fig. 1.

debt-to-GDP ratio during the period 1954–2008 exceeds 50%. The remaining 11 countries are used for Fig. 4(B). Next we look at 7 countries for which the maximum debt-to-GDP ratio recorded

during the period 1954–2008 exceeds 90% (Fig. 4(C)), which is the threshold reported by Reinhart and Rogoff (2010). The remaining 13 countries are used for Fig. 4(D).

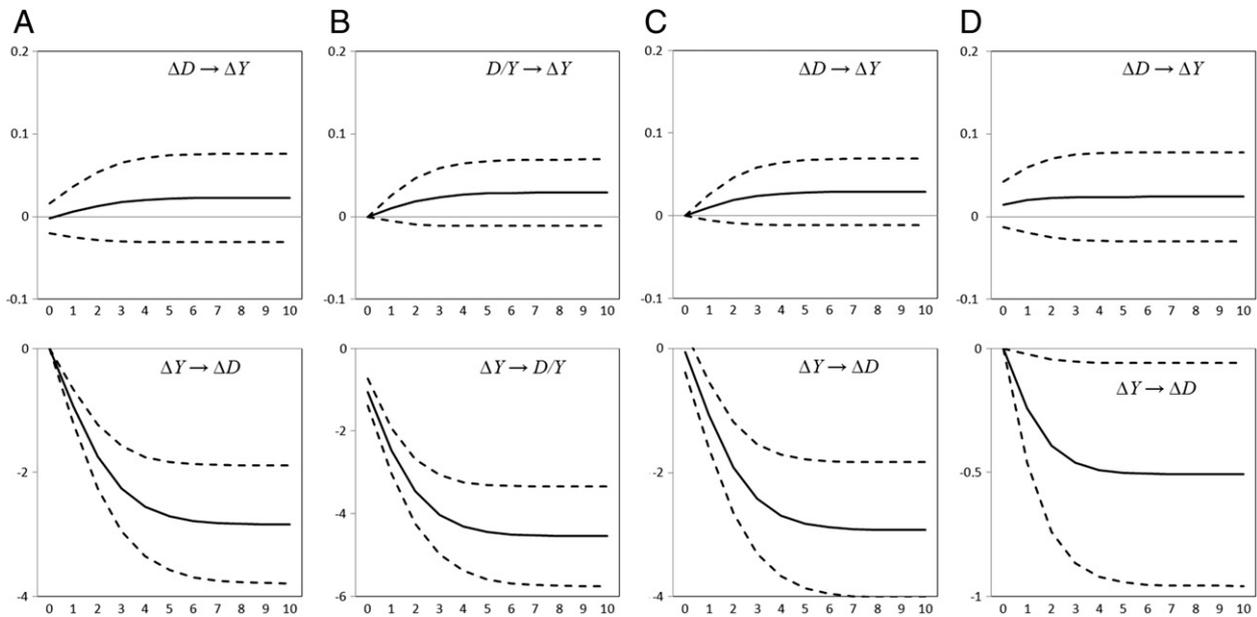


Fig. 3. Cumulative impulse-response functions for alternative VAR specifications. (A) Debt and GDP measured in aggregate terms. (B) Debt measured as Debt-to-GDP ratio. (C) Recursive order reversed. (D) Subsample of 10 countries with longer time-series.

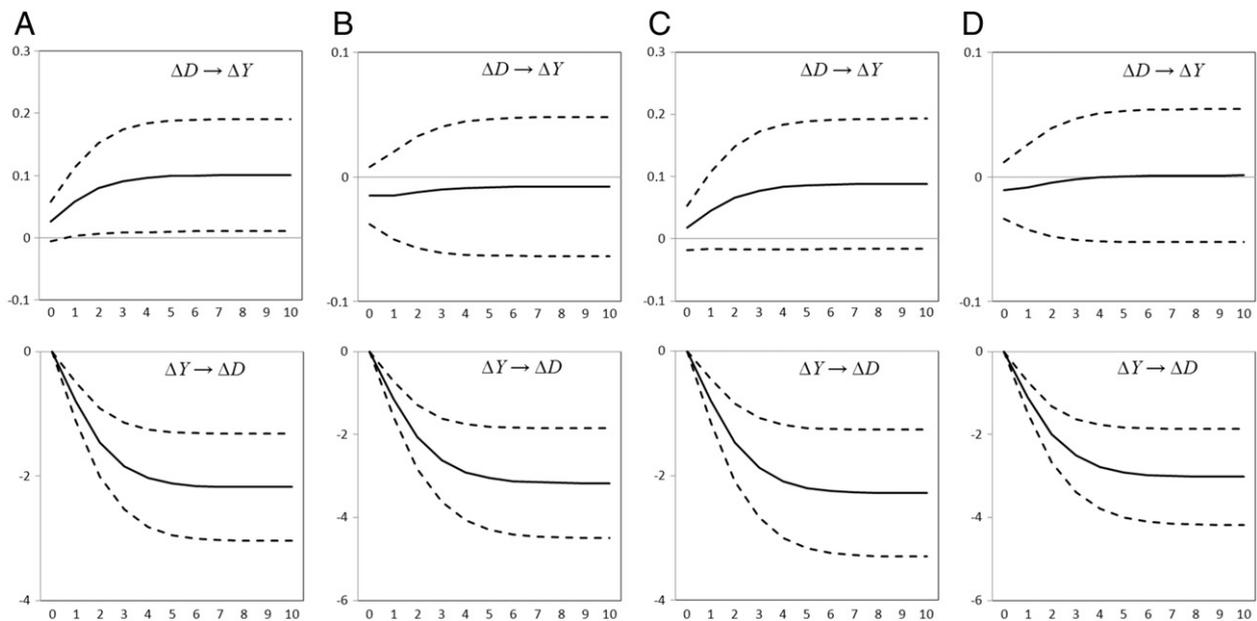


Fig. 4. Cumulative impulse-response functions for different subsamples. (A) Av. Debt-to-GDP ratio > 50% ($N = 9$). (B) Av. Debt-to-GDP ratio < 50% ($N = 11$). (C) Max. Debt-to-GDP ratio > 90% ($N = 7$). (D) Max. Debt-to-GDP ratio < 90% ($N = 13$).

Overall, the results in Figs. 3 and 4 seem highly similar to those presented in Fig. 2: we find no significant long-run effect of sovereign debt on economic growth. Instead, we find a negative effect of growth on debt.

4. Conclusion

High levels of sovereign debt are surely a burden to a country, but according to our results, the effect of debt on growth is ambiguous, at best. We find no statistically significant long-run effect of debt on economic growth, for any elevated level of debt. This result is robust to alternative VAR specifications and various samples. GDP growth, on the other hand, is found to have a statistically significant negative effect on sovereign debt. This implies that the

negative long-run correlation between the sovereign debt and GDP growth is mainly driven by the negative effect of economic growth on sovereign debt.

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