Appendix: Robustness exercises for the paper "How does Financial Vulnerability affect Housing and Credti shocks?"

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In this Appendix, we illustrate the main robustness exercises to the benchmark specification.

The Smooth Local projections The high parametrization of standard local projections (Jordá [2007]) can produce impulse responses featuring high variability. In order to cope with this issue and increase the efficiency in the estimation of the coefficients of the model, Barnichon and Brownlees [2018] propose to use the Smooth Local projections: through the use of B-Splines the coefficients of each horizon are jointly estimated and smoothed, allowing to obtain less erratic impulse responses. We apply this method to our benchmark exercise. Results are ported in Figure 1 for housing shock and in Figure 2 for credit shock are overall in line with the results found in the benchmark specification.

Estimation with 3 lags We test our results by estimating our model with three lags (rather than two as used in the benchmark estimation). As shown in Figure 3 and 4 we find similar state effects as the ones found in the benchmark specification both concerning housing and credit shocks.

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Different smoothing parameters for the transition variable   We report the impulse responses obtained by estimating the STLP with alternative calibrations for the smoothing transition parameter: $\theta = 1.5$ (high smoothing) and $\theta = 5$ (low smoothing). In both cases, results confirm the same finding as the one of the benchmark estimation. In Figure 5 and 6, we report the impulse responses for housing and credit shocks when $\theta = 1.5$, while in Figure 7 and 8 we report the responses when $\theta = 5$. Results are marginally affected by the choice of the smoothing parameter.

Use of the DSR in level   Figures 9 and 10 report the results by using the DSR in levels. Results are qualitatively similar to the benchmark specification. The main difference with respect to the benchmark specifications is that the positive effect of housing shock, which is amplified in the first part of the projection, is overturned after two years since the arrival of the shock.

Transformations of the DSR: 2-years and 4-years differences   We estimate the benchmark model by using alternative transition variables. Figures 11 and 12 report the results by using the DSR computed in 2-years difference, while Figures 13 and 14 report the results using the DSR expressed in its 4-years difference. Results are qualitatively similar to the ones obtained under the benchmark specification.

Policy rates: Fed funds rate and One year Government bond rate   In the main specification we use the shadow short term rate by Wu and Xia [2016] as policy rate. In this paragraph we report the results obtained different policy rates. First, in Figures 15 and 16 we report the impulse responses to housing and credit shocks by using the observed short term rate. Second, in line with Gertler and Karadi [2015] we use the one year government bond rate, which is expected to incorporate information on the future path of policy rates and can better incorporate the forward guidance framework featuring the period of Zero Lower Bound. For both specifications we find the same state effects as the ones found in the benchmark specification.

References

R. Barnichon and C. Brownlees. Impulse response estimation by smooth local projections. *The Review of Economics and Statistics*, 0(0):1–9, 2018. doi:

10.1162/rest_a_00778. URL `https://doi.org/10.1162/rest_a_00778`.

M. Gertler and P. Karadi. Monetary policy surprises, credit costs, and economic activity. *American Economic Journal: Macroeconomics*, 7(1):44–76, 2015.

Jordá. Estimation and inference of impulse responses by local projections. *American Economic Reviews*, 2007.

J. C. Wu and F. D. Xia. Measuring the macroeconomic impact of monetary policy at the zero lower bound. *Journal of Money, Credit and Banking*, 48(2-3):253–291, 2016. URL `https://EconPapers.repec.org/RePEc:wly:jmoncb:v:48:y:2016:i:2-3:p:253-291`.

Smooth Local Projections: Housing shock
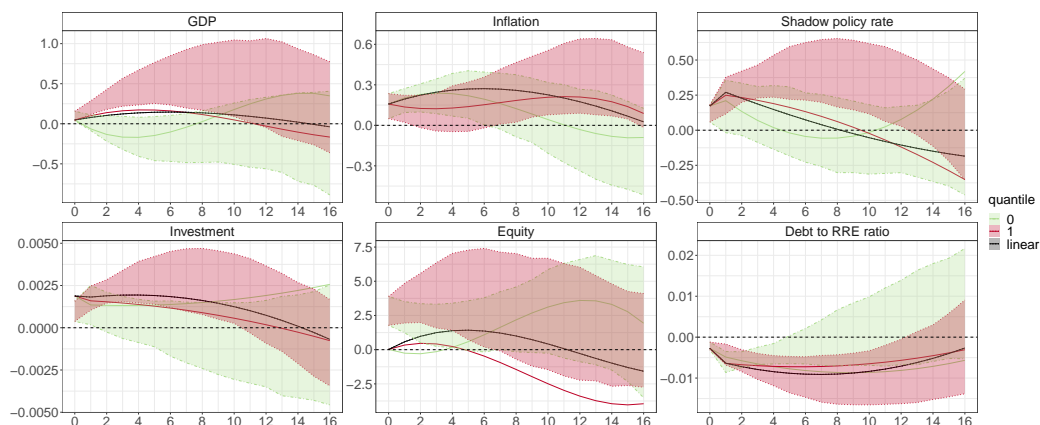
Figure 1: Impulse responses of a of output growth to a housing shock.
Note. The responses of output growth and equity growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.
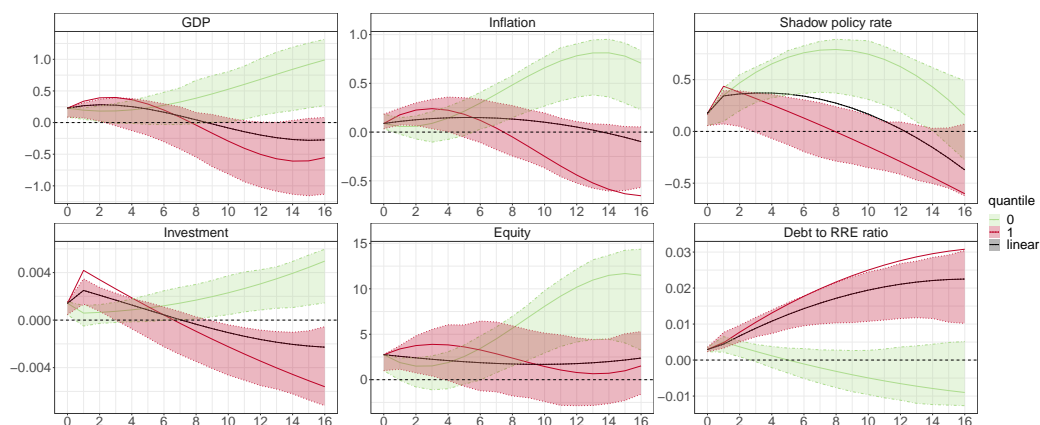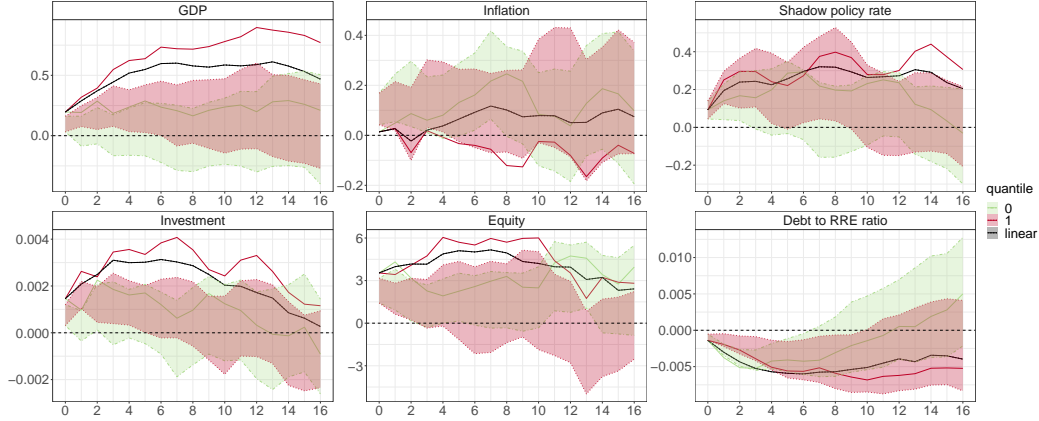
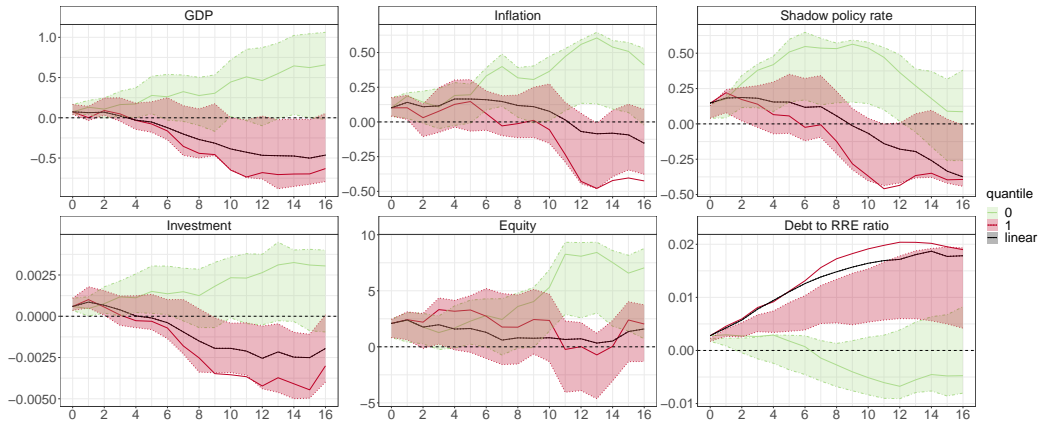**Smooth Local Projections: Credit shock**

Figure 2: Impulse responses of output growth to a credit shock.
Note. The responses of output growth and equity growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.
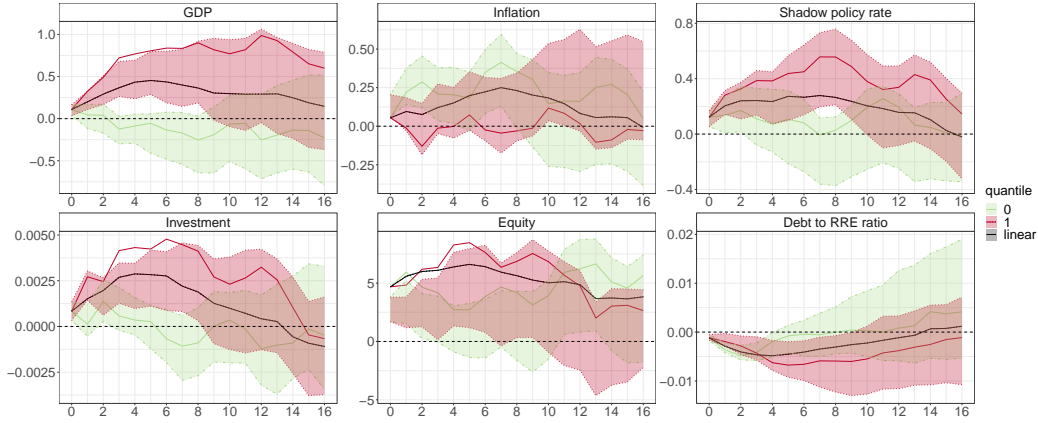
3 lags: Housing shock

Figure 3: Impulse responses of a of output growth to a housing shock.
Note. The responses of output growth and equity growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.
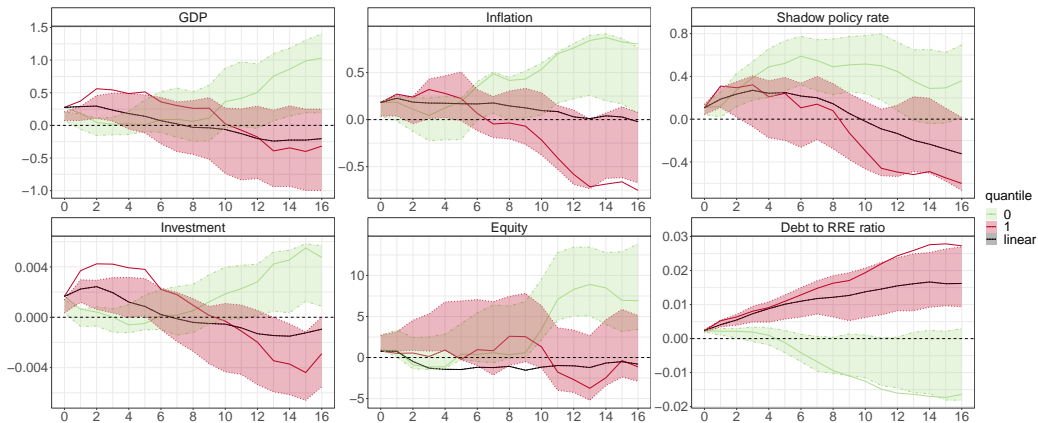
3 lags: Credit shock

Figure 4: Impulse responses of output growth to a credit shock.
Note. The responses of output growth and equity growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.
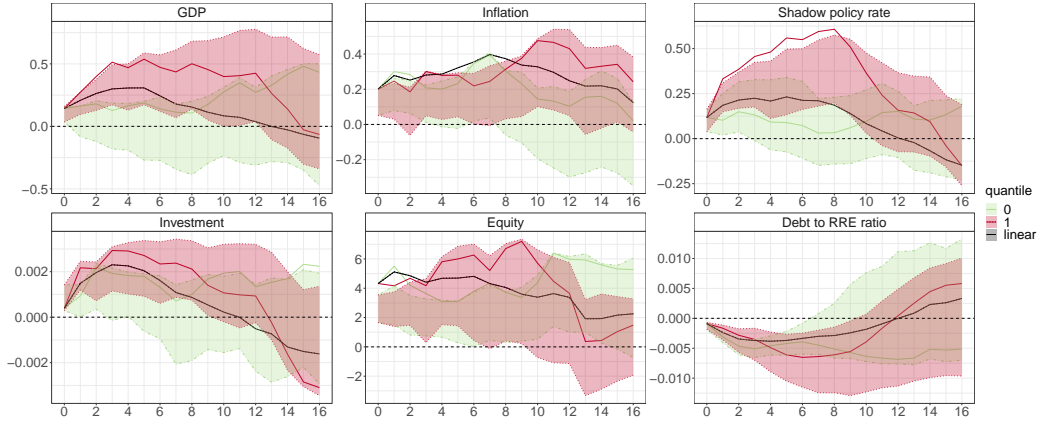
$\theta = 1.5$: Housing shock

Figure 5: Impulse responses of a of output growth to a housing shock.
Note. The responses of output growth and equity growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.
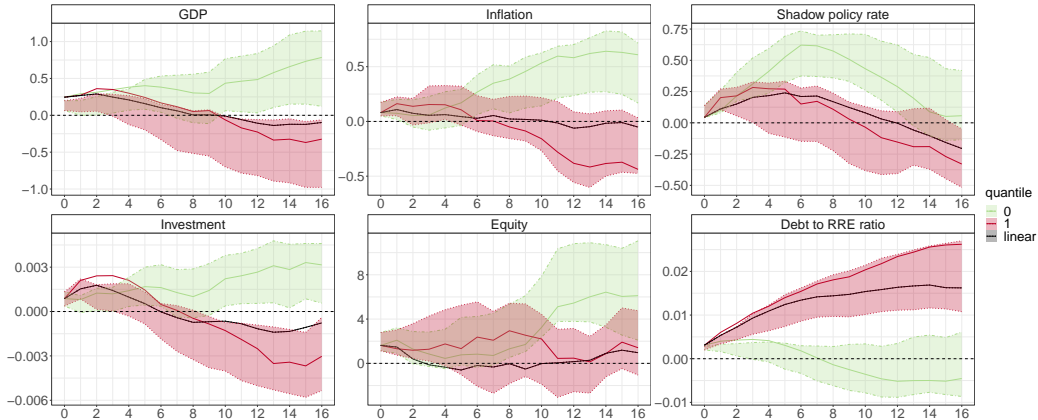
$\theta = 1.5$: Credit shock

Figure 6: Impulse responses of a of output growth to a credit shock.
Note. The responses of output growth and equity growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.
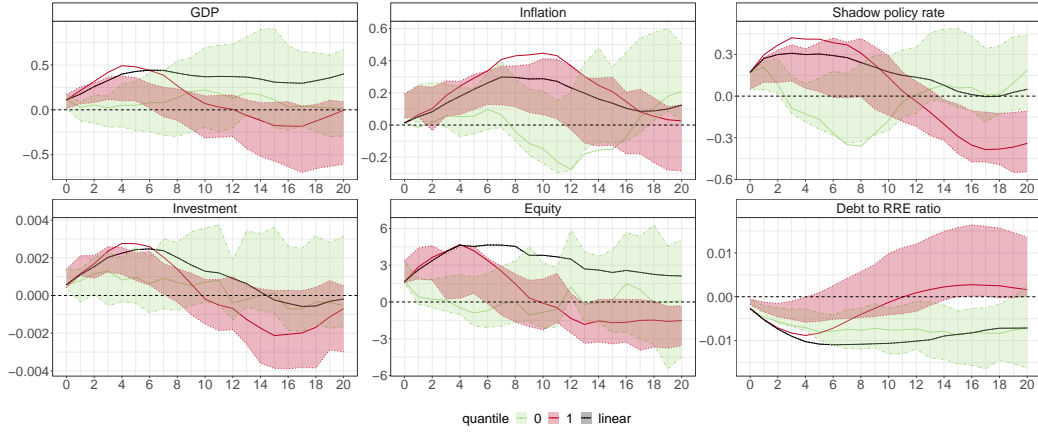
θ = **5**: **Housing shock**

Figure 7: Impulse responses of a of output growth to a housing shock.
Note. The responses of output growth and equity growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.

θ = **5**: **Credit shock**

Figure 8: Impulse responses of output growth to a credit shock.
Note. The responses of output growth and equity growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.
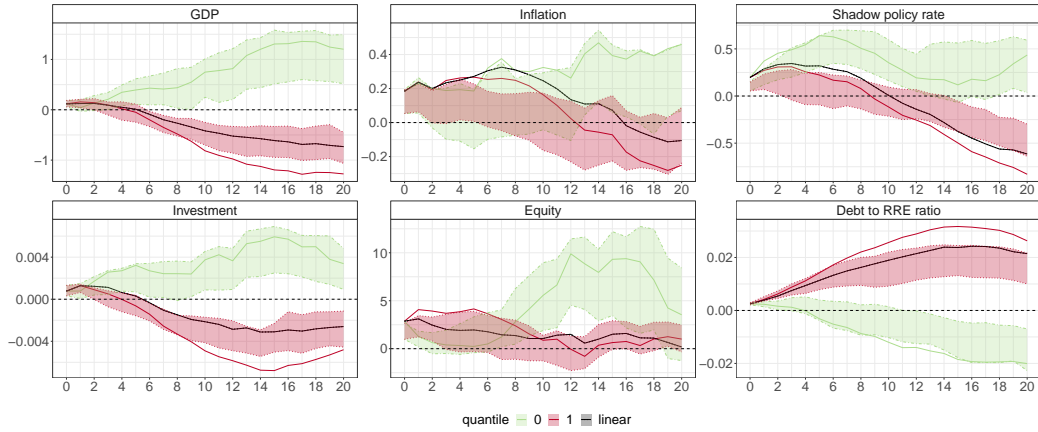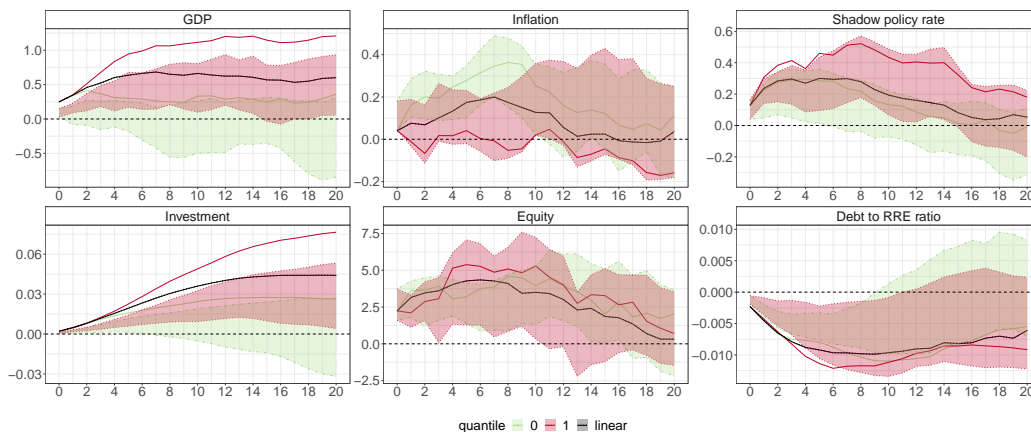
DSR in level: Housing shock

Figure 9: Impulse responses of a of output growth to a housing shock.
Note. The responses of output growth and equity growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.

DSR in level: Credit shock

Figure 10: Impulse responses of a of output growth to a credit shock.
Note. The responses of output growth and equity growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.

2 years DSR: Housing shock

Figure 11: Impulse responses of a of output growth to a housing shock.
Note. The responses of output growth and equity growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.
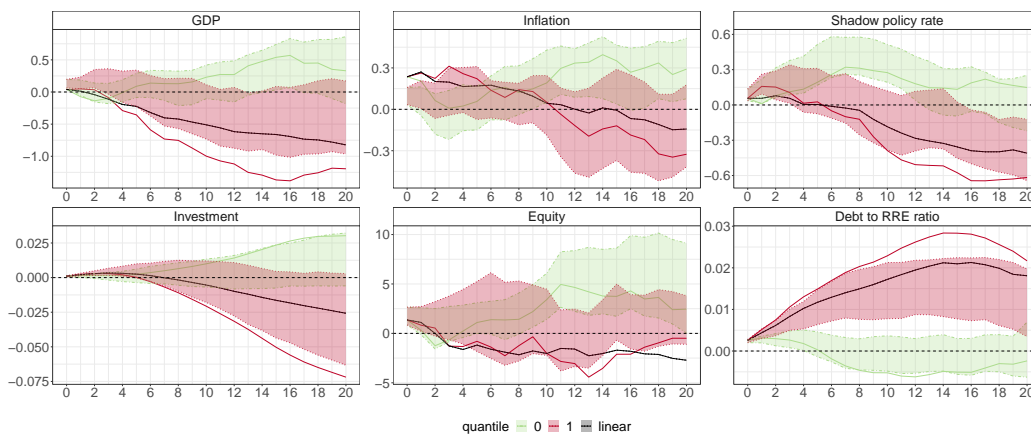
2 years DSR: Credit shock

Figure 12: Impulse responses of a of output growth to a credit shock.
Note. The responses of output growth and equity growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.
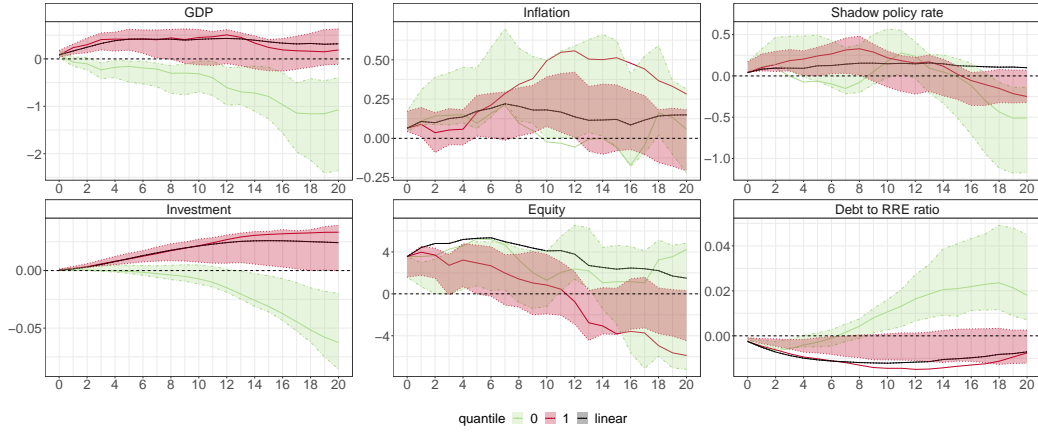
4 years DSR: Housing shock

Figure 13: Impulse responses of a of output growth to a housing shock.
Note. The responses of output growth and equity growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.
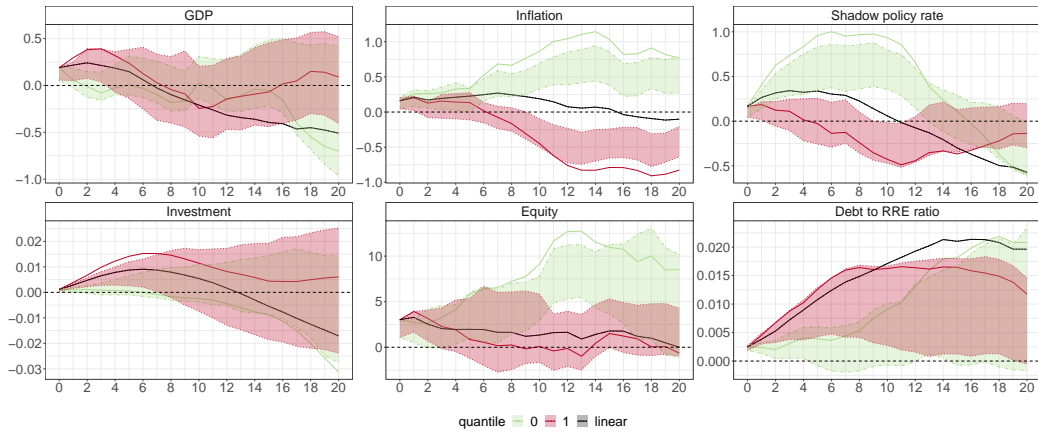
4 years DSR: Credit shock

Figure 14: Impulse responses of a of output growth to a credit shock.
Note. The responses of output growth and equity growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.
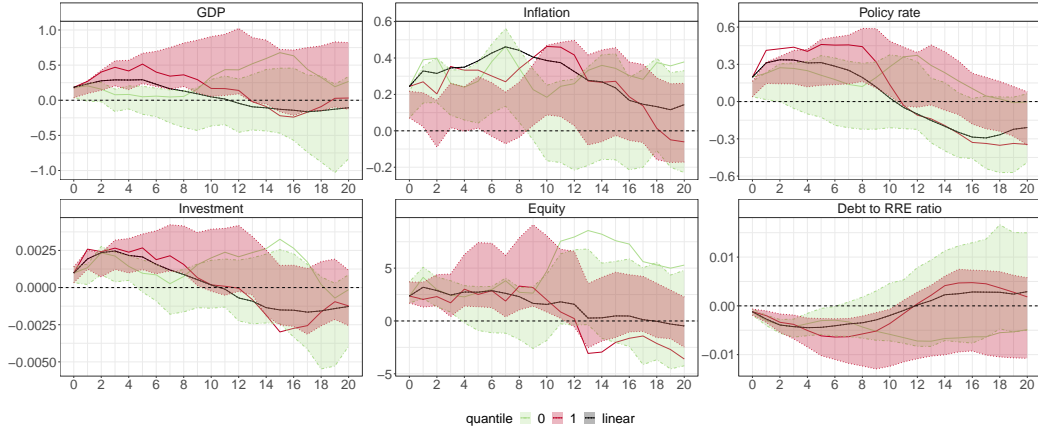
Short-term rate: Housing shock

Figure 15: Impulse responses of a of output growth to a housing shock.
Note. The responses of output growth and equity growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.
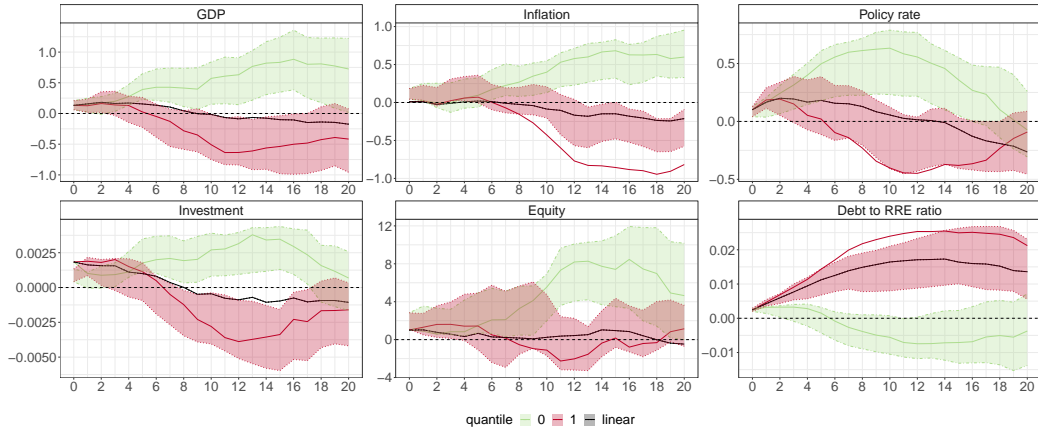
Short term rate: Credit shock

Figure 16: Impulse responses of a of output growth to a credit shock.
Note. The responses of output growth and equity growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.

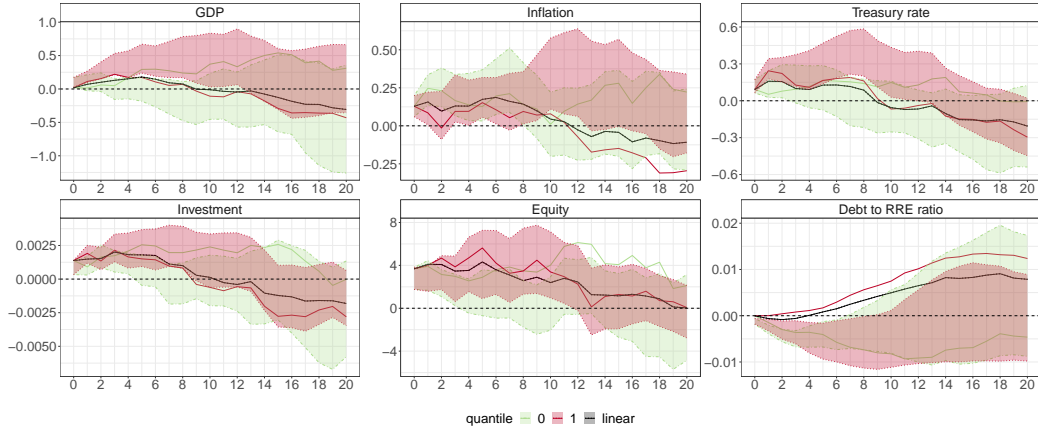**One year government bond rate: Housing shock**

Figure 17: Impulse responses of a of output growth to a housing shock.
Note. The responses of output growth and equity growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.
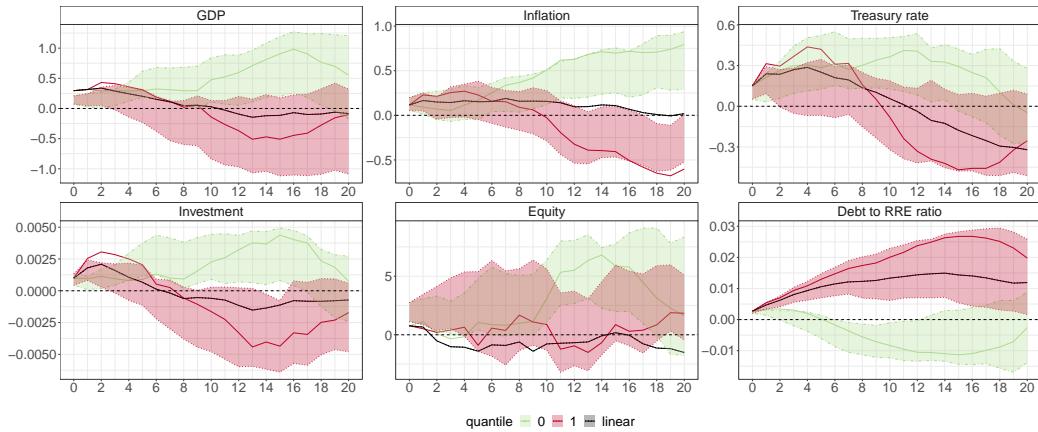
One year government bond rate: Credit shock

Figure 18: Impulse responses of a of output growth to a credit shock.
Note. The responses of output growth and equity growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.