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The Dynamics of Business Investment Following Banking Crises and Normal Recessions

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1996 | April 2015

Web: www.ifw-kiel.de

Kiel Working Paper 1996 | April 2015

The Dynamics of Business Investment Following Banking Crises and Normal Recessions*

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Abstract:

I empirically analyze the dynamics of business investment following normal recessions (declines in business investment that are not associated with banking crises) and banking crises. Using a panel of 16 advanced economies, I find evidence for significant non-linear trend reversion or bounce-back effects on the level of business investment following normal recessions, i.e., the deeper the previous recession was, the higher the growth rate of business investment will be. The trend reversion effect is absent when a decline in business investment is associated with a banking crisis. As a consequence, normal recessions do not have significant permanent effects on the level of business investment, whereas banking crises have large and significant permanent effects. The results are in line with important theories and other empirical results on business cycle dynamics.

Keywords: Business investment, business cycle, recovery, banking crises, asymmetries

JEL classification: E32, C33

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*I would like to thank Jens Boysen-Hogrefe, Jonas Dovern, Stephane Dees, and Maik Wolters for very valuable comments and suggestions.

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The Dynamics of Business Investment Following Banking Crises and Normal Recessions

1. Introduction

Business investment is a main driver of business cycle dynamics, as it is very pro-cyclical, and at the same time, it is key for the long-run prospects of an economy because it determines the capital stock that is available for future production. While the dynamics of business investment over the business cycle have generally been intensively analyzed, relatively little attention has been paid to the analysis of the dynamics of business investment in recoveries.¹ However, a better understanding of business investment dynamics in recoveries is important for an assessment of the strength of the overall recovery and for an assessment of whether a recession may have a long-run impact on potential growth.

In this paper, I empirically analyze the dynamics of business investment in recoveries. I differentiate between recoveries following normal recessions (recessions that are not associated with banking crises) and recoveries following banking crises because, according to the results in the literature, these recoveries may exhibit very different dynamics. Using an autoregressive panel model with 16 advanced economies, I allow for non-linear dynamics in recoveries by considering a term that can account for potential trend reversion or bounce-back effects on the level of business investment.

A significant bounce-back effect would indicate that the deeper the previous recession was, the higher the growth rate of business investment in a recovery will be. This approach is related to that of Beaudry and Koop (1993) and was recently used by Boysen-Hogrefe et al. (forthcoming) to estimate the strength of recoveries in terms of GDP following normal recessions and recessions associated with banking and housing crises.

My results indicate that there is a significant bounce-back effect on the level of business investment following normal recessions. This bounce-back effect is absent in recoveries following banking crises. As a consequence, the permanent effects of normal recessions on the level of investment are much lower compared to banking crises.

2. Data Description

For the empirical investigation I have to rely on a panel data set because banking crises are very rare events. I use a panel of 16 advanced economies with annual data running from 1970 to 2013.²

¹ Notable exemptions are Claessens et al. (2009), Claessen et al. (2011), Jorda et al. (2013), and Schularick and Taylor (2012). However, in these studies methodologies other than those in this study are used and the dynamics of gross fixed capital formation (including public and housing investment) rather than of business investment are analyzed.

² These countries are Australia, Belgium, Canada, Denmark, Finland, France, Germany, Great Britain, Italy, Japan, the Netherlands, Norway, Spain, Sweden, Switzerland, and the United States.

Business investment (private fixed investment except housing) is taken from the OECD Economic Outlook. For three countries (Italy, Spain, Switzerland) this series is not available. For these three countries, I use gross fixed capital formation except housing (but including public investment) as a proxy. Data for real GDP are also taken from the OECD Economic Outlook.

I identify a recession as a year with a negative growth rate in annual business investment. Usually this approach is applied to GDP instead of business investment when identifying recessions (see, e.g., Jorda et al. 2013); however, I use business investment because it is the center of interest in this analysis. As a consequence, a recession as identified in this paper does not necessarily coincide with negative GDP growth rates.³ The identification of banking crises follows the narrative approach of Laeven and Valencia (2013). According to the definition used here, a recession is associated with a banking crisis when the banking crisis starts during a recession or in the two years before a recession. Overall, there are 90 recessions and 17 banking crises in the sample. According to the identification criteria 16 of these 17 banking crises are associated with recessions.⁴

3. Empirical methodology

I test for the existence of a bounce-back effect by extending an autoregressive fixed effects panel model for annual growth in business investment $\Delta y_{i,t}$ in country i in year t with a so-called current depth of recession ($cdr_{i,t}$) term that measures the difference between the current level in business investment and its previous peak (in percent):

$$\Delta y_{i,t} = \alpha_i + \beta_1 \Delta y_{i,t-1} + \gamma_1 cdr_{i,t-1} + \varepsilon_{i,t}, \quad (1)$$

where α_i denotes the country fixed effects, β_1 measures the impact of the autoregressive terms of investment growth, and γ_1 measures the impact of the cdr term. According to Beaudry and Koop (1993), the cdr term is calculated as the difference between the current log-level in business investment y_t and its previous peak:

$$cdr_t = \max (y_{t-j})_{j \geq 0} - y_t. \quad (2)$$

The cdr term takes positive values when business investment is below its previous peak (e.g., during recessions when investment has declined) and is zero otherwise (e.g., during expansions). The cdr term allows testing for the existence of bounce-back effects on the level of business investment during recoveries. A positive value for γ_1 indicates that there may be a bounce-back effect on the level of business investment because in this case investment growth is higher when investment is below its previous peak. However, for a final assessment on whether a bounce-back effect indeed

³ I show later that my results are robust independently whether I use business investment or GDP to identify recessions.

⁴ In the appendix, I provide a chart with a data overview.

occurs, and the AR-Dynamics and the country-fixed effects have to be taken into account. I differentiate between normal recessions and banking crises by including an interaction term $cdr_{i,t}^{bc}$ between the cdr term and a dummy variable that takes a value of one when a recession has been associated with a banking crisis in (1):

$$\Delta y_{i,t} = \alpha_i + \beta_1 \Delta y_{i,t-1} + \gamma_1 cdr_{i,t-1} + \delta_1 cdr_{i,t-1}^{bc} + \varepsilon_{i,t} \quad (3)$$

A negative value for δ_1 indicates that the bounce-back effect on business investment is weaker when the previous recession was associated with a banking crisis. Equations (1) and (3) could be easily extended by more lags; however, tests based on the Akaike Information Criterion and the Schwarz Information Criterion indicate that it is appropriate to include one lag of the autoregressive term, one lag of the cdr term, and one lag of the interaction term in the model.⁵

4. Estimation Results

I start by estimating equation (1), which does not differentiate between normal recessions and banking crises, and find that there is evidence that growth in business investments in recoveries is moderately stronger the deeper the previous recession was. The parameter estimate of 0.22 for γ_1 indicates that for every 1% that business investment is below its previous peak, growth in business investment is 0.22 percentage points higher (Table 1, specification I). When I differentiate between normal recessions and banking crises the results show that recoveries in business investment are considerably stronger when they follow normal recessions (0.4 percentage points additional growth for every 1% business investment is below its previous peak) than when they follow banking crises (0.17 percentage points, specification II).⁶ A likelihood ratio test indicates that the model in specification II that differentiates between normal recessions and banking crises fits the data significantly better than the model in specification I at a significance level of 1%.

However, the fact that the estimated parameter values for the term $cdr_{i,t}$ are positive and significantly different from zero does not necessarily imply that there is indeed a bounce-back effect on the level of business investment in recoveries (i.e., growth in business investment is higher than steady-state growth) because the autoregressive dynamics could counteract the bounce-back-effect. Therefore, I compute impulse response functions based on specification (II) to investigate whether a bounce-back effect occurs. I use a simulation approach to account for the non-linearity of the model (Potter 2000).⁷ The impulse response functions show that after a normal recession, a bounce-back

⁵ When I include second lags, the parameter estimates for these lags are not significantly different from zero at the 10% -level, and the results for the first lags are essentially equal to those reported for specification II (for detailed results see the appendix).

⁶ A Wald test indicates that the parameter value of the cdr term and the parameter value of the banking crises interaction terms are significantly different from each other in absolute terms.

⁷ Due to non-linearity, the shape of the impulse response functions depends on the size of the initial shock. However, the impulse-response functions are qualitatively similar for all reasonable sizes of the initial shock.

effect on the level of business investment can be observed: Growth in business investment is considerably higher for several years beginning in the second year after the recession compared to the baseline of no recession (Figure 1, Panel A). The level of business investment remains below the growth path of the baseline (no recession); however, the baseline is within the 95% confidence intervals, indicating that normal recessions do not have a significant permanent effect on the level of business investment (Panel C). Following a banking crisis, growth in business investment shows no sign of a bounce-back effect (Panel B), and the level of business investment is significantly lower than that of the baseline (Panel D).

Table 1:
Estimation results

| | I (1970-2012) | II (1970-2012) | III (1970-2007) |
|---------------------------|------------------------------|-------------------------------|-------------------------------|
| β_1 | 0.41 ^{***} (9.6) | 0.45 ^{***} (10.4) | 0.48 ^{***} (10.3) |
| γ_1 | 0.22 ^{***} (5.9) | 0.40 ^{***} (6.7) | 0.38 ^{***} (6.0) |
| δ_1 | | -0.23 ^{***} (4.0) | -0.24 ^{***} (3.6) |
| <i>adjusted R-squared</i> | 0.12 | 0.14 | 0.15 |

Notes: Annual data. Dependent variable: Real private GFCF except housing (Italy, Spain, Switzerland: real GFCF except housing); panel model for 16 advanced economies from 1970-2013; *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively; t-statistics in parentheses.

While the aim of this paper is to provide stylized facts on business cycle dynamics of business investment rather than rigorously testing theories of the business cycle, the results can be related to several important theories and other empirical results in the literature. The results for normal recessions are in line with the plucking model of business fluctuations (Friedman 1993) and indicate that during normal recessions wait-and-see effects that are related to higher uncertainty of firms (see, e.g., Bloom 2009) may play a prominent role. The result that business investment is very sluggish following banking crises is in line with theories suggesting that such crises are usually preceded by mal-investment that have to be corrected for in the aftermath of a crisis (see, e.g., Hayek 1933 and Mises 1953 or Minsky 1986) but may also be due to lower expectations about potential output (Furceri and Mouroungane 2012) and to financial constraints (see, e.g., Campello et al. 2010).⁸

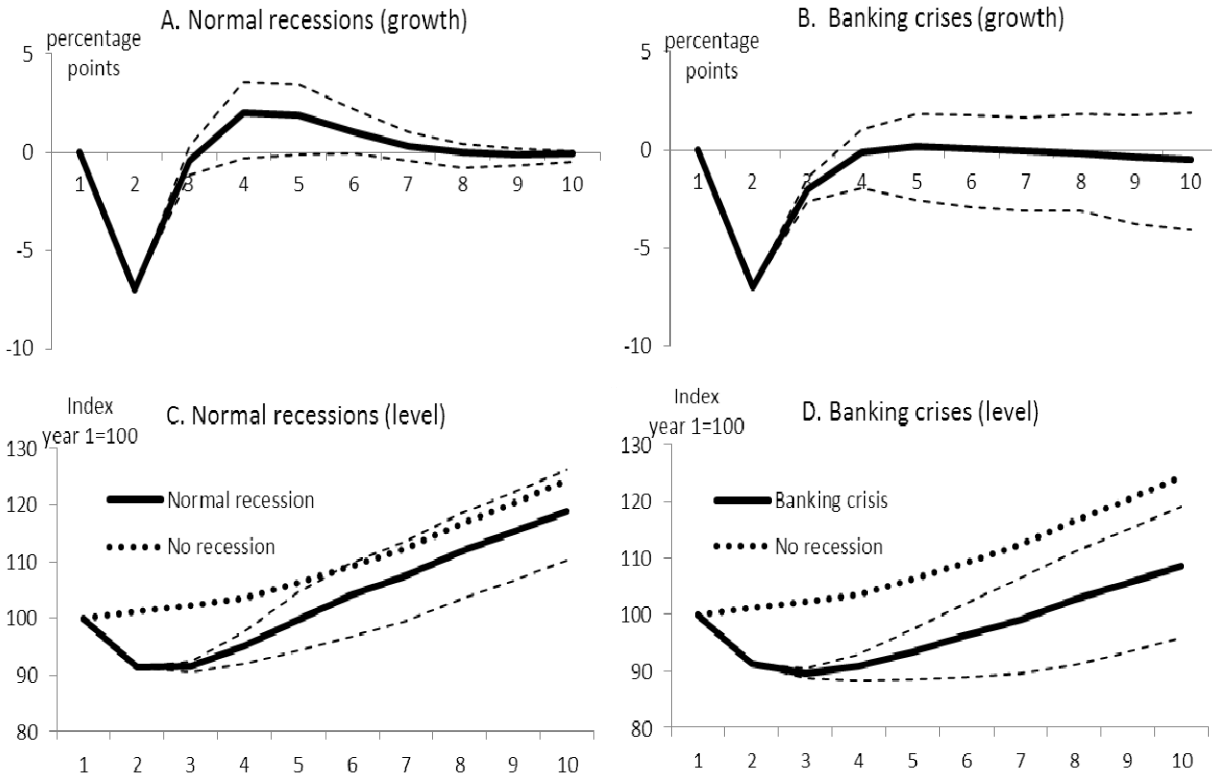
For the charts, impulse-response functions for a negative shock of 7% in investment are used, which corresponds to one standard deviation of growth in business investment in the data set used here. For more details on the simulation procedure, see the appendix.

⁸ To that extent that banking crises are accompanied by recessions that are deeper than a normal recession, the results are also in line with results for the United States that deeper recessions are more likely to have permanent effects on the level of GDP (Wolters and Hosseinkouchack 2013).

5. Robustness of the Results

The results are robust when I restrict the sample to the period before 2007, i.e., the period before the banking crises of 2007/2008 started (Table 1, Specification III). It is notable that the results are not only qualitatively robust but also quantitatively robust, indicating a good out-of-sample forecast performance of the model estimated until 2007 for the period thereafter. Moreover, the results are robust when time-fixed effects (e.g., to control for global developments) or when GDP growth (contemporaneously and lagged; to control for accelerator effects) as an explanatory variable are included in the regression, although the estimated parameter values become somewhat smaller. The results are also robust when I exclude Italy, Spain, and Switzerland from the sample, for which I have used a different variable to measure business investment compared to the other economies. Finally, the results are also robust when I identify recessions using GDP instead of using business investment.⁹

Figure 1:
Business investment following normal recessions and banking crises



Notes: Annual data. GDP growth in Panel A and B: Deviation from baseline of no recession. Based on 1000 simulations taking into account parameter uncertainty and the non-linearity of the model (by drawing randomly shocks from a normal distribution with zero mean and a standard deviation set equal to the standard deviation of investment growth). Simulations are run for a shock that leads to a decrease of 7% in investment in year 2. Dotted lines in Panel C and D indicate the level of business investment in the baseline case of no recession in year 2. Dashed lines indicate the 95% confidence intervals.

⁹ The detailed results of the robustness checks are in the appendix.

6. Conclusion

In this paper, I empirically analyze the dynamics of business investment following normal recessions and banking crises. Using a panel of 16 advanced economies, I find evidence for significant bounce-back effects on the level of business investment following normal recessions, i.e., the deeper the previous recession was, the higher the growth rate of business investment will be. This bounce-back effect is absent when a decline in business investment is associated with a banking crisis. As a consequence, the permanent effects of normal recessions on the level of business investment are much lower compared to banking crises. The results for normal recessions are in line with the plucking theory of the business cycle and indicate that wait-and-see effects that are related to higher uncertainty of firms may play a prominent role. The result that recoveries in business investment are very sluggish following banking crises is in line with theories, suggesting that such crises are usually preceded by mal-investments that have to be corrected for in the aftermath of a crisis but may also be due to financial constraints and due to lower expectations about potential output.

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8. Appendix

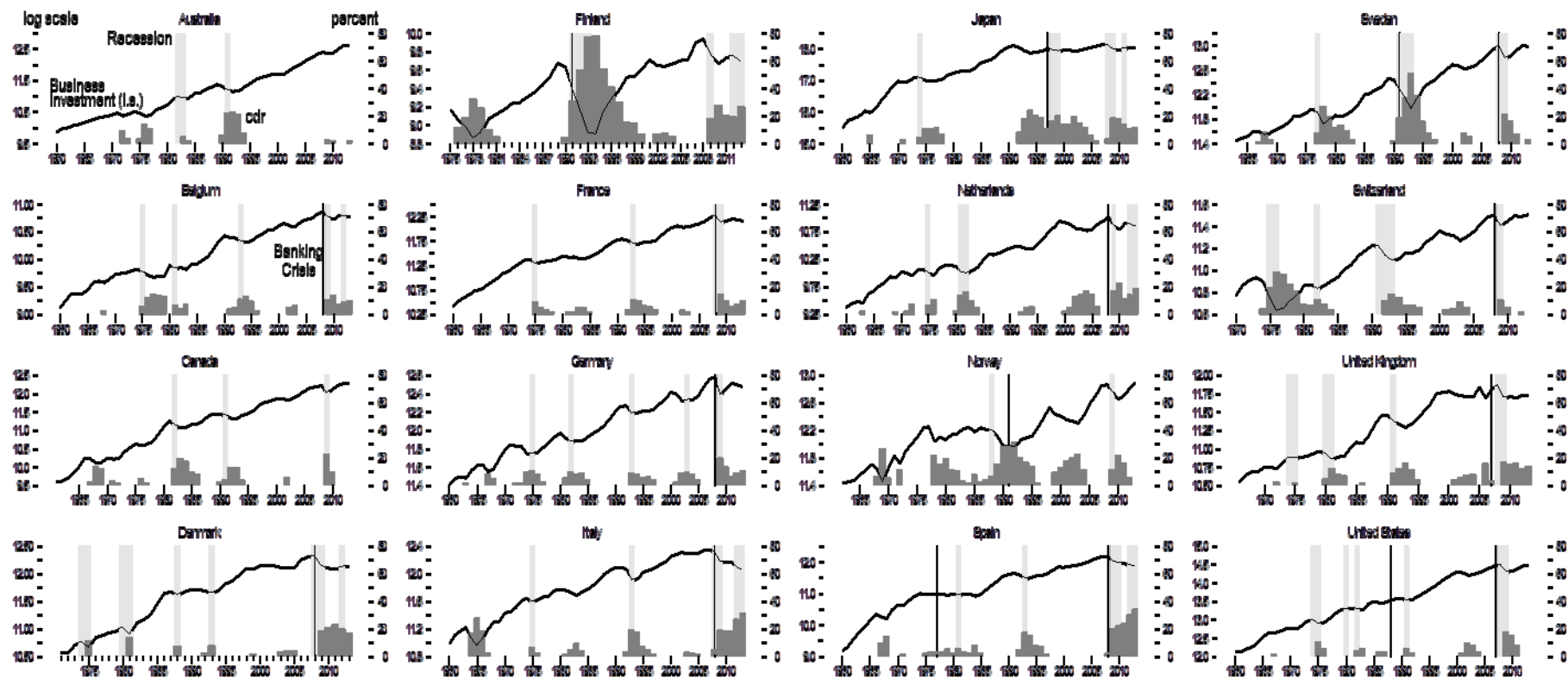
In the appendix, I graphically illustrate my data set, present the detailed results of the robustness checks, and describe in more detail how I compute the impulse-response functions.

8.1 Appendix A: Graphical illustration of the data set

Fluctuations in business investment exhibit heterogeneous patterns across economies and across time (Figure A.1). In recessions, the declines in business investment can go as high as 80 percent, as in the case of Finland in 1996. However, the Finland result is an outlier in terms of the decline in business investment, and in many recessions, the decline is below 10 percent. Recessions identified via declines in GDP (shaded areas) and recessions identified as declines in the level of business investment (increases of the *cdr* term in Figure 8.1) sometimes exhibit somewhat different patterns with regard to the start or the duration of declines in GDP and in business investment. However, declines in GDP and in business investment usually coincide with each other.¹⁰ While all countries were hit by at least two recessions, two countries (Australia and Canada) were not hit by a single banking crisis. Most of the banking crises in the sample started in 2007 or 2008.

¹⁰ While declines in GDP are almost always accompanied by decline in business investment, there are several periods when declines in business investment are not accompanied by declines in GDP.

Figure A.1: Data Overview



Notes: A description of the Figure is located at the upper left. Shaded areas indicate recessions as identified by declines in annual GDP; periods with declines in the level of business investment (or with increases in the *cdr* term) are equivalent to periods of recessions as identified via. The start of banking crises is indicated with vertical black lines.

8.2 Robustness checks

I perform six robustness checks:

- (I) I include time-fixed effects to control for internationally synchronized developments.
- (II) I include GDP growth as explanatory variable (contemporaneously and lagged) to control for accelerator effects.
- (III) I exclude Italy, Spain, and Switzerland from the sample, for which I have used a different variable to measure business investment compared to the other economies.
- (IV) I check whether dynamics of business investment in recession and recovery periods differ when recessions are identified as declines in annual GDP growth instead of declines in annual growth in business investment.
- (V) I include second lags in model (3).
- (VI) I control for the recession in Finland that began in 1990.

Table A.1:
Results of the robustness checks¹¹

| | I | II | III |
|-----------------------|-------------------------------|-------------------------------|-------------------------------|
| β_1 | 0.34 ^{***} (7.6) | 0.28 ^{***} (6.8) | 0.44 ^{***} (10.3) |
| γ_1 | 0.28 ^{***} (5.0) | 0.27 ^{***} (6.1) | 0.47 ^{***} (6.0) |
| δ_1 | -0.16 ^{***} (3.0) | -0.10 ^{**} (2.2) | -0.27 ^{***} (3.7) |
| <i>Adj. R-squared</i> | 0.42 | 0.53 | 0.14 |
| | IV | V | VI |
| β_1 | 0.44 ^{***} (10.2) | 0.52 ^{***} (7.1) | 0.45 ^{***} (10.3) |
| γ_1 | 0.45 ^{***} (6.4) | 0.50 ^{***} (4.2) | 0.40 ^{***} (6.7) |
| δ_1 | -0.26 ^{***} (2.8) | -0.30 ^{***} (2.9) | -0.22 ^{***} (3.4) |
| <i>Adj. R-squared</i> | 0.14 | 0.14 | 0.14 |

Notes: Annual data. Only parameter estimates for the three ‘core’ variables are reported but not those of additional regressors; Dependent variable: Real private GFCF except housing (Italy, Spain, Switzerland: real GFCF except housing); panel model for 16 advanced economies from 1970-2013; *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively; t-statistics in parentheses.

¹¹ To ensure the readability of the results, I report only the parameter estimates for three ‘core’ variables for each of the robustness checks. More detailed results can be made available on request.

Overall, the results are robust with regard to all of the six robustness checks. When including time-fixed effects (Table A.1, specification I) or GDP growth (contemporaneously and the first lag, parameter estimates not reported, specification II), the parameter estimates for the *cdr* term and the interacted *cdr* term become somewhat smaller. However, when interpreting these results it should be taken into account that both specifications are extreme cases that make it most unlikely to find evidence in favor of a bounce-back effect (e.g., when including GDP growth, it does not control for feedback effects from business investment on GDP). When Italy, Spain, and Switzerland are excluded from the sample (specification III) or when I additionally control for recessions identified as declines in annual GDP (by including interaction terms between the investment *cdr* terms and a 1/0 dummy-variable that takes a value of one in a recession identified via GDP, parameter estimates not reported, specification IV), the results remain essentially unchanged. When I include second lags in model (3), the parameter estimates remain essentially unchanged, while all of the parameter estimates for the second lags are not significantly different from zero at the 10%-level (specification V, parameter estimates for the second lags not reported). Finally, I control for the recession in Finland that began in 1990 (by including a variable that is equal to the *cdr* term for Finland between 1990 and 2000 and zero otherwise in model 3). The results indicate that the recession in Finland does not have a significant impact on the overall results (specification VI, parameter estimate for the variable that I use to control for the recession in Finland not reported).

8.3 Impulse-response functions

I compute impulse-response functions that compare the “typical” growth paths of business investment without recessions with the typical growth paths when an economy is either hit by a normal recession or by a banking crisis. For computing the typical growth paths, I use a simulation approach. A simulation approach is necessary due to the non-linearity of the models. To account for negative shocks that may hit the economy after the shock in the initial period, I compute impulse-response functions in line with the work of Potter (2000). First, I derive the steady-state growth in business investment in a hypothetical ‘average’ economy of my panel. Therefore, I calculate the unconditional mean of growth in business investment in my panel, which is equal to 2.9 percent. In each simulation it is assumed that growth in business investment in the period before the economy was hit by a negative shock (either due to a normal recession or due to a banking crisis) is equal to this unconditional mean. Then, I repeat the following steps 1,000 times and calculate the impulse response functions as the mean of these 1,000 draws:

1. Draw parameter estimates from a multivariate normal distribution, with the mean given by the point estimates and the variance covariance matrix given by the variance covariance matrix of regression coefficients.
2. Randomly draw a sequence of shocks for the periods 3 to 10 from a Gaussian distribution with a mean of zero and the estimated standard deviation over all residuals of the model, which is 7.
3. Compute a baseline forecast for business investment in the absence of any shock in period 2.

4. Compute a forecast for business investment for a negative shock in period 2 that leads to a decline in business investment of 7 percent when the economy was hit by a normal recession.
5. Compute a forecast for business investment for a negative shock in period 2 that leads to a decline in business investment of 7 percent when the economy was hit by a banking crisis.

To compute the baseline forecast in step 3, I use an AR-1 model based on the results of specification (II) shown in Table 1 with the AR-1 parameter equal to the parameter estimate of β_1 augmented by a constant term of -0.2, which equals the average over all estimated country fixed effects. To compute the forecast in step 4, I augment this model by the parameter estimate for the *cdr* term from specification (II) in Table 1:

$$\Delta y_{i,t} = -0.2 + 0.45\Delta y_{i,t} + 0.4cdr_{i,t} \quad (\text{A.1})$$

To compute the forecast in step 5, I augment equation (A.1) by the parameter estimate for the interacted *cdr* term:

$$\Delta y_{i,t} = -0.2 + 0.45\Delta y_{i,t} + 0.4cdr_{i,t} - 0.23cdr_{i,t}^{bc} + \varepsilon_{i,t} \quad (\text{A.2})$$

When computing the forecasts following a negative shock associated with a banking crisis, I switch from equation (A.2) to equation (A.1) once business investment has reached its former peak. In doing so, I interpret any further negative shock that hit the economy before business investment has reached its former peak as being related to the banking crisis and any further negative shocks that hit the economy after business investment has reached its former peak as being related to a new (normal) recession.