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The ugly and the bad: banking and housing crises strangle output permanently, ordinary recessions do not

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## **Working Papers**

**Kiel Institute  
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**The Ugly and the Bad: Banking and  
Housing Crises Strangle Output  
Permanently, Ordinary Recessions  
Do Not**

**by Jens Boysen-Hogrefe, Nils  
Jannsen, and Carsten-Patrick Meier**

**1586 | January 2010**

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## **The Ugly and the Bad: Banking and Housing Crises Strangle Output Permanently, Ordinary Recessions Do Not**

Jens Boysen-Hogrefe, Nils Jannsen, and Carsten-Patrick Meier\*

### Abstract:

This paper provides statistical evidence suggesting that in industrial countries, recessions that are associated with either banking crises or housing crises dampen output far more than ordinary recessions. Using a parametric panel framework that allows for a bounceback of the level of output in the course of the cyclical recovery, we find that ordinary recessions are followed by strong recoveries that make up for almost all the preceding shortfall in output. This bounceback tends to be significantly smaller following recessions associated with banking crises or housing crises. Our paper corroborates the practice of focusing exclusively on severe crises used in an emerging macroeconomic literature and integrates it with the earlier literature on recessions and recoveries.

Keywords: Business cycle, banking crisis, housing crisis, panel data, asymmetry, persistence

JEL classification: E32, C33

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## **1 Introduction**

The effects of recessions on economic activity and in particular the durations of recessions as well as the strength and profile of the recoveries following them, remain subject to substantial uncertainty. This uncertainty impedes making effective macroeconomic forecasts and obstructs devising optimal policy responses. Macroeconomists have long tried to forecast recessions, albeit with little success. Are they also bound to fail at forecasting recoveries?

A key result of the empirical literature initiated by the work of Nelson and Plosser (1982) and Campbell and Mankiw (1987), was that recoveries typically do not turn out to be strong enough for output losses engendered by recessions to be completely regained. This result was later challenged by Beaudry and Koop (1993) who argued that the statistical framework used in the earlier studies was too restrictive. By implicitly requiring recessions and recoveries to proceed symmetrically, the earlier studies effectively biased their findings towards permanent effects of recessions on output. Once GDP was allowed to grow stronger in the quarters following a recession, evidence was found that GDP bounced back to its pre-recession level.

A limitation of this early literature on the profile of recoveries is that it was largely confined to an investigation of the post-war macroeconomic history of a small number of industrialized countries, notably the US. Analyzing data from a much larger sample of countries, Kaminsky and Reinhart (1999) were the first to document systematically that recessions associated with financial crises turn out to be particularly severe. Similarly Cerra and Saxena (2005a) showed that six Asian countries suffered permanent output losses from the Asian crisis beginning at 1997. However, despite the financially driven decade-long slump in Japan and the banking crises in the Nordic countries in the 1990s, it was not until the onset of the Great Recession of 2008/2009 that it occurred to most macroeconomic researchers that not all recessions may be alike, even in industrialized countries. Apparently, previous research on recessions and recoveries had accidentally focused too much on less interesting, tranquil times.

This, indeed, seems to be the assessment of a number of recent studies on recessions triggered by severe crises and the following recoveries. Starting from the proposition that severe crises break away from the ordinary, linear course of events, these studies abandon linear empirical methods of analysis. In an effort to “separate the extraordinary from the ordinary” (Cecchetti et al. 2009), they typically start with identifying periods of severe crises

which are usually approximated by banking or financial, housing, currency and political crises. They then concentrate on finding similarities and typical patterns between these periods. The data set they use usually includes both OECD and non-OECD countries. Ignited partly by Reinhart's and Rogoff's (2008) attempt to draw lessons for the course of the US subprime crises from historical episodes with financial crises in other countries across the last centuries, a number of recent studies have investigated recessions triggered by severe crises and their aftermath (Reinhart and Rogoff 2009a and 2009b, Cecchetti et al. 2009, Haugh et al. 2009). The general finding of these studies is that recessions triggered by severe crises are followed by rather weak and slow recoveries, and thus have long lasting effects on output.

Our paper adds to the literature in two ways. First, while the studies cited above have clearly expanded professional understanding of severe crises in an important way, by their very design they are silent on the comparative aspects of "extraordinary" recessions which are associated with severe crises versus "ordinary" recessions which are rather normal in the business cycle. This is a shortcoming that we attempt to address. Following recent work by the International Monetary Fund (IMF 2009a), we focus on what differentiates severe crises and their subsequent recoveries from ordinary recessions and their subsequent recoveries, albeit using a somewhat broader definition of crises and using a parametric framework that, among others things, allows inference on the critical question whether output losses from recessions are regained in the subsequent recoveries. As a side-effect, the paper integrates the new nonparametric literature on severe crises with the earlier parametric macroeconomic literature on recessions and recoveries.

Second, while the majority of the new studies on severe crises have analyzed data from both developed and less-developed countries in an attempt to obtain meaningful sample sizes, it is not clear whether the results can really be taken as indicative for industrialized countries, given that severe crises in less-developed countries often dominate the samples and that market structures, institutions, risk perceptions, etc., may differ sharply between industrialized and nonindustrialized countries. Indeed, Cecchetti et al. (2009) find that severe crises are "quite diverse" and that the data for the US and the UK from the Great Recession of 2008/2009 have a unique status in their sample of 40 banking crises in 35 countries since 1980. Our study, therefore, follows the IMF (2009a) and Claessens et al. (2009) and discards the information on severe crises in emerging market and developing countries and focuses on industrialized countries.

We start from the observation that in industrialized countries severe crises have typically been associated with banking crises or with housing crises, whereas currency crises and political crises, in contrast, only played minor roles (see, e.g., Reinhart and Rogoff 2009b). We thus set out to determine whether recessions in industrialized countries that were associated with either banking crises or housing crises (or both) were more severe than ordinary recessions, whereby severity is measured by the degree to which the output losses associated with the recession are reversed in the subsequent recovery. To avoid a downward bias in the estimated recovery, we base our estimates on the nonlinear statistical framework suggested by Beaudry and Koop (1993). Hence, our analysis narrows down to testing whether the size of the bounceback of GDP following an ordinary recession is larger than that following a recession associated with a banking crisis or housing crisis.

In the remainder of the paper, we provide evidence that this is indeed the case. In particular, we find that while recessions always tend to have permanent negative effects on the level of output, the effects of ordinary recessions are of marginal magnitude compared to recessions associated with banking or housing crises that dampen output strongly. Our results corroborate the practice, in studies such as Reinhart and Rogoff (2008, 2009), of focusing exclusively on severe crises and they corroborate the findings of significant economic effects of such crises. In addition, our findings also partly confirm those of Cerra and Saxena (2008) and IMF (2009b), who are methodologically close to our study but work with a linear statistical framework and follow previous practices by looking at a combined sample of industrialized and nonindustrialized countries. Indeed, our non-linear estimates imply that the output losses associated with severe crises are even more persistent than found by Cerra and Saxena (2008).

The structure of the remaining paper is as follows. Section 2 describes our data set and explains our estimation strategy. Section 3 presents estimation results and illustrates them graphically. Section 4 reports the results of several robustness checks and Section 5 summarizes the results and concludes.

## **2 Data and Estimation Strategy**

Our research plan amounts to test the hypothesis that ordinary recessions are usually followed by strong recoveries, while recessions that are associate with banking crises or housing crises or both are not. Therefore, we differentiate between recessions that seem to be a normal fluctuation in the business cycle (ordinary recessions) and those that are triggered by particular severe crises. Since, the term ‘severe crises’ is not well defined and rather ambiguous, we define them specifically as being banking and housing crises throughout this paper. These two types of crises are found by a large body of literature to cause, at least on average, exceptionally strong recessions.<sup>1</sup>

As severe crises are relatively rare events, we rely on a panel of countries. We restrict our analysis to industrial countries in order to ensure some amount of homogeneity within the panel as regards business cycle dynamics and the consequences of severe crises. Overall, the panel consists of 16 countries, namely Australia, Belgium, Canada, Denmark, Finland, France, Germany, Great Britain, Greece, Italy, Japan, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United States. We use yearly GDP data from 1970 to 2006 from the OECD Economic Outlook (2009).

In the literature, it is common to identify housing crises by means of real house price developments. Phases of strong price declines (Ahearne et al. 2005 or IMF 2003) or alternatively phases of prices far below the trend (Detkens and Smets 2004 or Bordo and Jeanne 2002) are defined as housing busts. We build on Ahearne et al. (2005) and the IMF (2003) and define the starting year of a housing crisis as the peak of real house prices within a rolling window of nine years, followed by a price decline of at least 7.5 percent in the following four years.<sup>2</sup> Using this method, we identify 29 housing crises in our sample.<sup>3</sup>

As appropriate time series indicators of banking crises are lacking, certain events like, for example, bank runs or closures of relevant financial institutions are usually used to detect such crises. In this paper, we use the dating scheme of Reinhart and Rogoff (2009a), which is based on Caprio and Klingebiel (2005), among others, to identify banking crises in our sample, of which there are 16. To model particular strong recoveries subsequent to recessions,

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<sup>1</sup> Compare Claessens et al. (2008), IMF (2003) and Reinhart and Rogoff (2008), among others.

<sup>2</sup> Real house price data for the countries in our sample were provided by the Bank of International Settlements.

<sup>3</sup> The results are considerably stable with respect to the length of the rolling window and the necessary price decline. Later on, we provide robustness checks of our results when using various dating schemes for housing crises.

we utilize, following Beaudry and Koop (1993), a current-depth of recession (*cdr*) term as measure of the output loss during a recession. The *cdr* term is defined as deviation of current GDP from its former maximum:

$$cdr_t = \max(Y_{t-j})_{j \geq 0} - Y_t, \quad (1)$$

where  $Y_t$  denotes log GDP in year  $t$  and  $\max(Y_{t-j})_{j \geq 0}$  refers to the peak of log GDP until year  $t$ . When GDP falls below its former maximum or alternatively when GDP growth is negative,  $cdr_t$  becomes positive. Throughout this paper, we define a recession as a period of negative GDP growth. This seems appropriate for industrial countries and yearly data. Therefore, during expansions,  $cdr_t$  is equal to zero. In our sample, this method identifies 41 phases with a positive *cdr* term, implying the same number of recessions.

Figures 1 and 2 show the (log) GDP, the *cdr* term, and the years in which the banking crises and housing crises began in the countries in our sample. Obviously, most of the crises were followed by recessions, which is indicated by positive values of  $cdr_t$ .

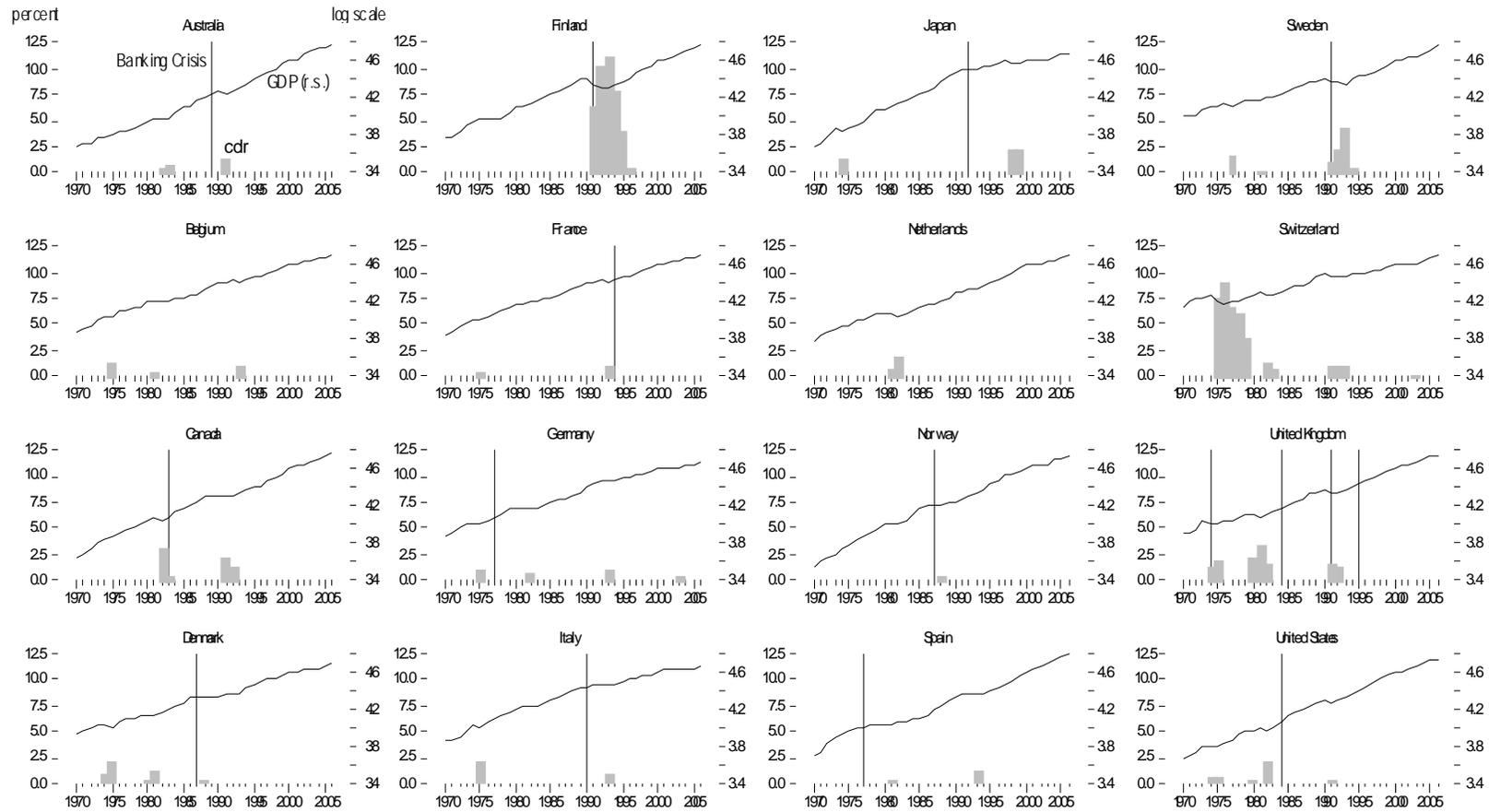
As we are interested in the existence and the strength of bounceback effects following ordinary recessions, we have to differentiate between ordinary recessions and recessions triggered by severe crises. Therefore, we consider a recession as being triggered by a banking crisis or a housing crisis if it begins within a period of two years after the crisis began.<sup>4</sup> It turns out that eight out of the 16 banking crises and 21 out of the 29 housing crises were followed by a recession.<sup>5</sup> Furthermore, seven out of eight banking crises were accompanied by a housing crisis. The only banking crisis not accompanied by a housing crisis, according to our criteria, took place in Australia in 1989. Since real house prices in this period declined by 7.2 percent, what is considerably close to our criterion of 7.5 percent, it is sensible to assume that two types of crises are present in our data set: banking crises that were accompanied by housing crises and (pure) housing crises.

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<sup>4</sup> We test the robustness of the results with regard to this definition later on (see the Appendix).

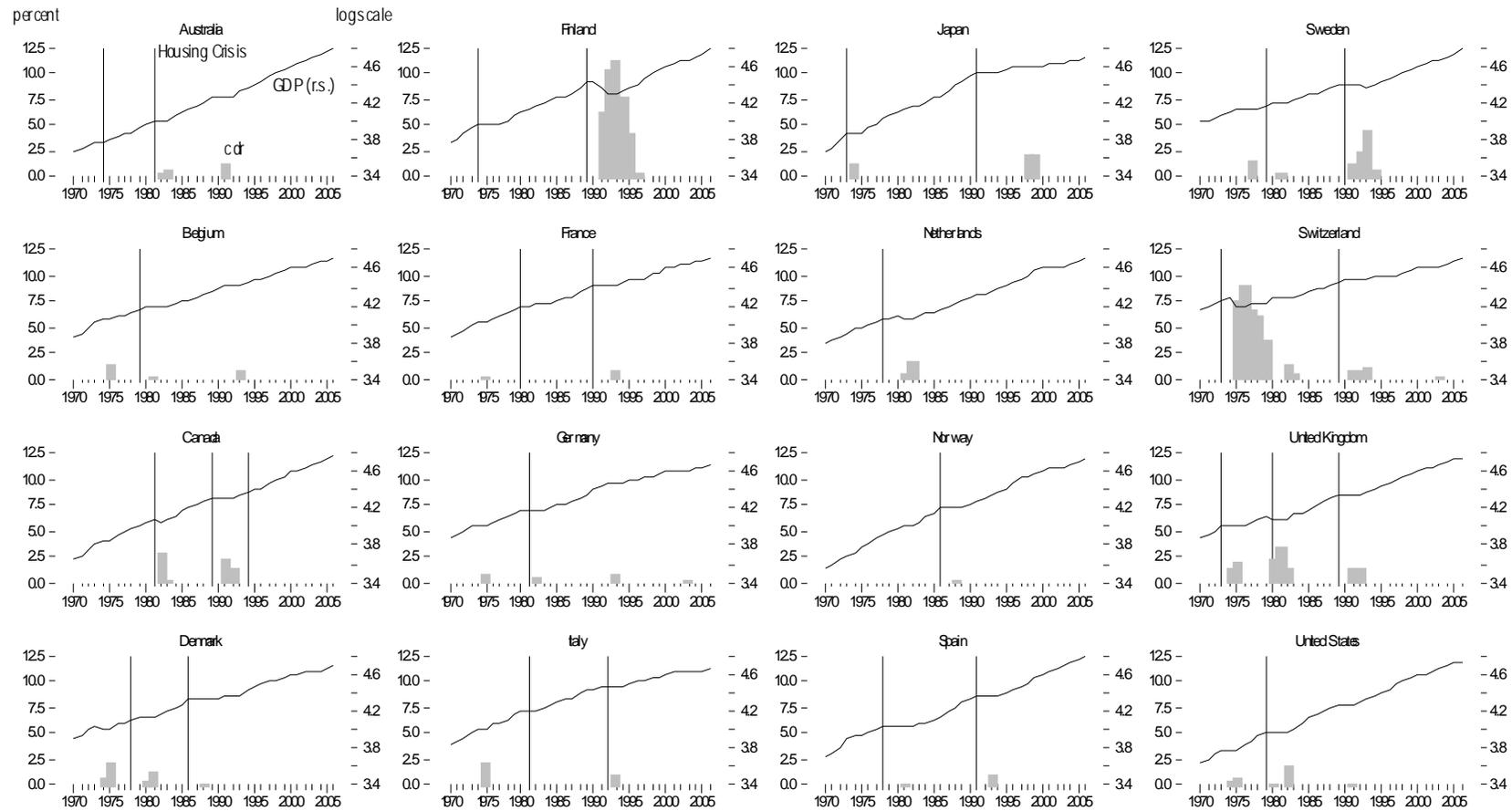
<sup>5</sup> Therefore, recessions in industrial countries have been frequently - roughly every second time - preceded by housing crises since 1970. As this result is robust even if we require a much larger price decline for identifying a housing crisis, it provides international evidence for the relevance of the private housing sector for the business cycle, which was analyzed in detail by Leamer (2007) for the United States.

Figure 1:  
GDP, Indicator of Current Depth of Recession and Banking Crises



Notes: Vertical lines indicate the year in which a banking crisis began.

Figure 2:  
GDP, Indicator of Current Depth of Recession and Housing Crises



Notes: Vertical lines indicate the year in which a housing crisis began.

To assess the impact of banking crises and housing crises on recovery, we define interaction terms for banking crises ( $cdr^{bc}$ ) and for housing crises ( $cdr^{hc}$ ), which take on the value of the  $cdr$  term if a recession was triggered by a banking crisis or a housing crisis and are zero otherwise.

The panel model is given as

$$\Phi(L)\Delta y_{t,i} = \alpha_i + [\Omega(L) - 1]cdr_{t,i} + [\Theta(L) - 1]cdr_{t,i}^{bc} + [\Pi(L) - 1]cdr_{t,i}^{hc} + \varepsilon_{t,i}, \quad (2)$$

where the lag polynomial of  $\Omega$  measures the impact of the  $cdr$  term. If the sum of all coefficients is positive, economic growth will on average be faster during recoveries than during expansions when the  $cdr$  term is zero. We estimate the effects of severe crises by including the interaction terms ( $cdr_{t,i}^{bc}$ ) and ( $cdr_{t,i}^{hc}$ ). If the sum of all coefficients for the respective interaction terms is negative, the hypothesis that recoveries following recessions that were associated with severe crises are weaker will be supported. In our baseline specification we allow for country-specific fixed effects ( $\alpha_i$ ).

### 3 Empirical Results

As our baseline model, we adopt an AR(2) model because preliminary tests show that the first two lags of GDP growth are highly significant in virtually any specification, while higher lags are usually not. In the following we estimate various specifications, which extend the baseline model by the  $cdr$  and the interaction terms.

In the first specification, we extend the baseline model by the first lag of the  $cdr$  term. We find a slightly positive parameter value, which is not significantly different from zero (Table 1). Overall, there seems to be no evidence in the data that indicate that recessions are followed by particularly strong recoveries. Including the second lag of the  $cdr$  term does not alter this result (specification II).

*Table 1:*  
Estimation Results

	I	II	III	IV
$\Delta y_{t-1,i}$	0.43 (9.7)	0.44 (8.6)	0.49 (10.8)	0.50 (9.8)
$\Delta y_{t-2,i}$	-0.16 (3.6)	-0.16 (3.5)	-0.17 (4.1)	-0.21 (4.3)
$\Delta cdr_{t-1,i}$	0.11 (1.4)	0.14 (1.1)	1.39 (4.7)	1.48 (4.9)
$\Delta cdr_{t-2,i}$		-0.04 (0.3)		-0.52 (1.7)
$\Delta cdr_{t-1,i}^{bc}$			-1.42 (4.7)	-1.76 (5.4)
$\Delta cdr_{t-2,i}^{bc}$				0.82 (2.4)
$\Delta cdr_{t-1,i}^{hc}$			-1.18 (3.9)	-1.17 (3.6)
$\Delta cdr_{t-2,i}^{hc}$				0.36 (1.1)
AIC	2163.0	2164.8	2143.9	2142.2
F-Test			0.79 / 0.08	0.92 / 0.24
Degrees of Freedom	525	524	523	520

*Notes:* *t*-values in parenthesis. First values of F-tests indicate the *p*-value of the hypothesis that the parameter values for the *cdr* terms and the banking crises interaction terms are identical. Second values refer to the housing crises interaction term *cdr* terms.

In specification III, we allow for heterogeneity among recessions and extend the first specification with the first lag of the interaction term for banking crises and housing crises. The parameter value of the *cdr* term, as well as the *t*-value, increases considerably. After an ordinary recession, GDP growth gets an extra boost, on average, of 139 percent of the overall output loss as long as GDP is below its former maximum level. Hence, in the absence of further negative shocks, GDP generally reaches its old level already after one year. When the recession was caused by a banking crisis, this effect vanishes completely and the parameter value of the interaction term becomes  $-1.42$ . When the recession was caused by a housing crisis, the parameter value is  $-1.18$ , which suggests that some bounceback effect occurs, but it is considerably weaker. The F-test confirms the hypothesis that the parameter values of *cdr* and the interaction term for banking crises are of equal size (*p*-value: 0.79). For housing crises, the evidence is somewhat weaker. The corresponding *p*-value is 0.08. Thus, when a recession is accompanied by one of the two types of crises, the bounceback effect observed following ordinary recessions is almost or even completely offset.

In specification IV, we augment the model by a second lag for each *cdr* term. It turns out that the business cycle effects in the first year following a recession are even more pronounced than in specification III. For the second, year the parameter values have the opposite sign, indicating some repercussion effect for each type of recession with or without a

severe crisis. Overall, the effects are qualitatively similar to those in specification III. Taken together, the parameter values of the first two lags of the *cdr* term are not significantly different from one, indicating that the output loss during an ordinary recession is completely offset in the following recovery. This is not the case when the recession was triggered by a banking crisis ( $p$ -value: 0.92) or a housing crisis ( $p$ -value: 0.24).

The Akaike Information Criteria favors the specifications that include the interaction terms for banking crises and housing crises and exhibits the lowest value for the specification IV that includes two lags of each variable. A likelihood-ratio-test indicates that specification IV fits the data better than specification I ( $p$ -value: 0.00), specification II ( $p$ -value: 0.00), and specification III ( $p$ -value: 0.05).

In the following, we assess the dynamic effects of recessions and severe crises graphically, using impulse response functions. With linear models, it is sufficient to compute a single impulse response function to illustrate the dynamics of a shock. This is not true for nonlinear models, where the shape of the impulse response function may depend on the sign and the size of the shock. Since we are interested exclusively in recessions, we concentrate only on negative shocks. Because the models discussed here are nonlinear under negative GDP shocks, we compute impulse response functions for different sizes of shocks, beginning with a size of minus one percent and proceeding up to minus nine percent for integer values.

To account for negative shocks that may hit the economy after the initial period, we employ impulse response functions in line with Potter (2000). First, we derive the steady state GDP growth of an average industrial economy in our panel. Therefore, we calculate the unconditional mean of GDP growth in our sample, which is 2.6 percent. Consequently, only negative shocks of more than minus 2.6 percent lead to negative GDP growth rates in the initial period and thus to nonlinear dynamics. Based on the steady state we calculate a baseline forecast in absence of any shock in the initial period and a forecast given a negative shock. For both forecasts, we allow the economy to be hit by further shocks beginning from the second period onwards. These shocks are drawn randomly from a Gaussian distribution with zero mean and the estimated standard deviation over all residuals of the model, which is 1.7. Finally, the difference between the baseline forecast and the forecast given a shock in the initial period is calculated for a horizon of 10 periods. This process is repeated 1,000 times. The average of the differences at each point in time yields the impulse response function.

For the calculations of the impulse response functions, we employ specification IV because the pairwise LR-tests favor this as the best performing model. When simulations are run for an ordinary recession, the interaction terms between the *cdr* term and the severe crisis dummies are supposed to be zero and we remain with the model

$$\Delta y_t = 1.7 + 0.47\Delta y_{t-1} - 0.17\Delta y_{t-2} + 1.39cdr_{t-1} - 0.44cdr_{t-2} + u_t, \quad (3)$$

where the constant 1.7 equals the average over all country-specific fixed effects.

When the recession is triggered by a severe crisis, the interaction terms are at work. The Wald test suggests that the parameter values of the *cdr* term and the interaction terms taken together are not significantly different from zero. Therefore, we simplify the model by excluding the *cdr* terms as long as the initial recession is over.<sup>6</sup> When the economy is hit by negative shocks later on, *cdr* dynamics are allowed for again. Thus, impulse responses are calculated by simulations from the following equation:

$$\Delta y_t = \begin{cases} 1.7 + 0.47\Delta y_{t-1} - 0.17\Delta y_{t-2} + u_t, & \text{until the } cdr_t \text{ term becomes zero the first time} \\ 1.7 + 0.47\Delta y_{t-1} - 0.17\Delta y_{t-2} + 1.39cdr_{t-1} - 0.44cdr_{t-2} + u_t, & \text{else} \end{cases}. \quad (4)$$

Figure 3 compares the resulting impulse response functions for GDP growth following a recession and a severe crisis. All impulse response functions are normalized by the absolute value of the initial shock. As mentioned before, the impulse response functions are identical for the first two shocks because GDP growth does not become negative in this case. For shocks stronger than minus two percent, GDP growth following ordinary recessions is considerably higher than in case of a severe crisis in the first two years of the recovery. Furthermore, ordinary recessions lead to higher growth rates than in the baseline during the recovery and thus to a bounceback of GDP. By contrast, GDP growth in the first two years following a severe crisis is lower than in the baseline. Due to nonlinearity, the bounceback effect following an ordinary recession is (relatively) more pronounced the stronger the initial shock.

In terms of the level of GDP, the economy catches up to the baseline rapidly in the case of an ordinary recession (Figure 4). However, as the confidence interval indicates, GDP is still

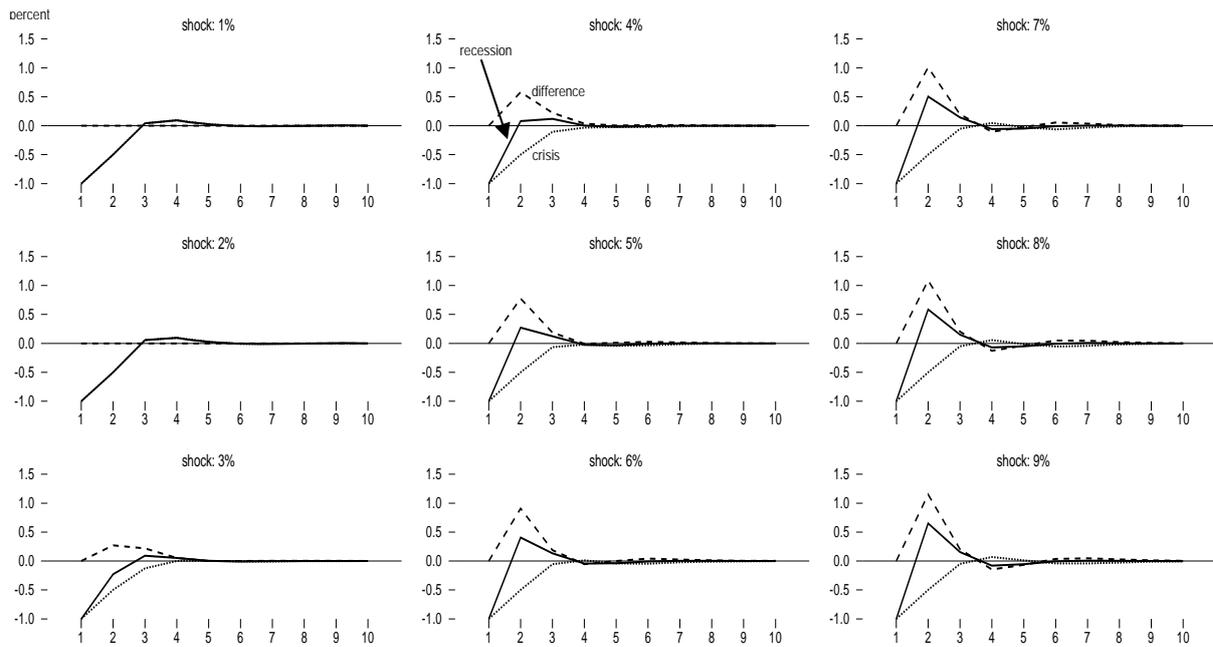
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<sup>6</sup> The alternative is to include either the interaction term for banking crises or for housing crises in the model. Both alternative specifications lead to virtually the same results as model (4).

likely to remain permanently below the baseline for all considered shocks.<sup>7</sup> Therefore, recessions have small but permanent effects on economic activity, even if a bounceback occurs. When a recession is triggered by a severe crisis, GDP permanently stays below the baseline at roughly 1.5 times the size of the shock. Additionally, GDP in this case is always significantly lower compared to an ordinary recession.

Figure 5 compares the relative strength of the bounceback effect following ordinary recessions in terms of level of GDP for different sizes of the initial shock. It turns out that the bounceback effect becomes relatively stronger with increasing size of the negative shock. However, the additional “strength” of the bounceback effect diminishes with increasing size of the shock.

Figure 3:  
GDP Growth: Deviation from Baseline

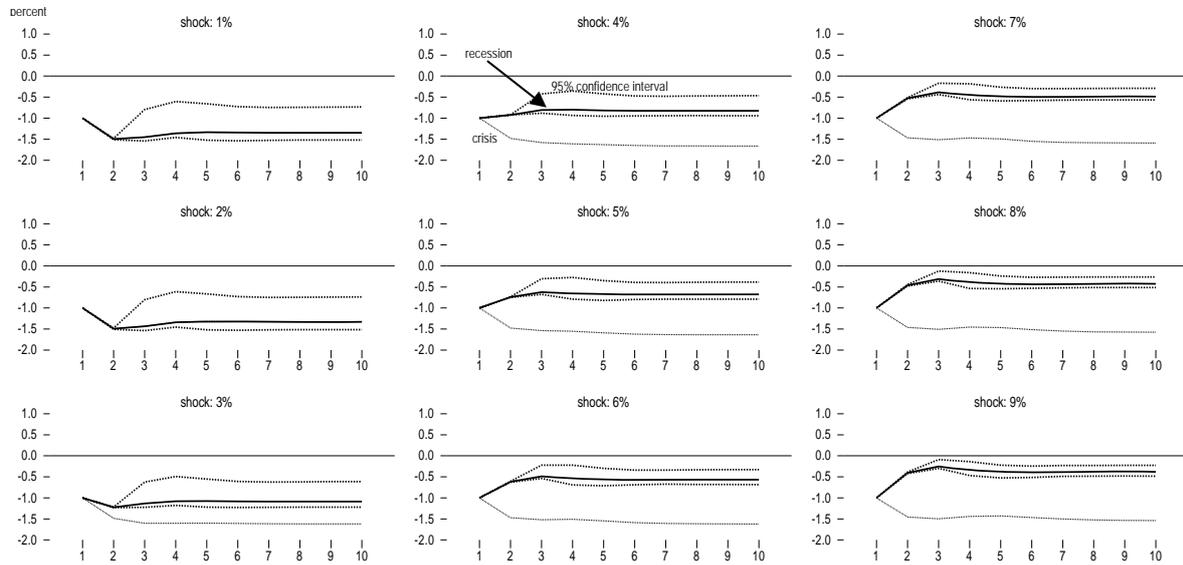


Notes: Impulse response functions are calculated as the difference to the baseline and are calculated as the mean over 1,000 bootstrap simulations. Impulse response functions are scaled by the absolute value of the respective shock.

<sup>7</sup> Beginning with a shock of roughly minus 15 percent, the long-run GDP level is not significantly below the baseline anymore. However, shocks of this size are very unlikely to be observed in industrial countries, in particular when the cause is not a banking or housing crisis.

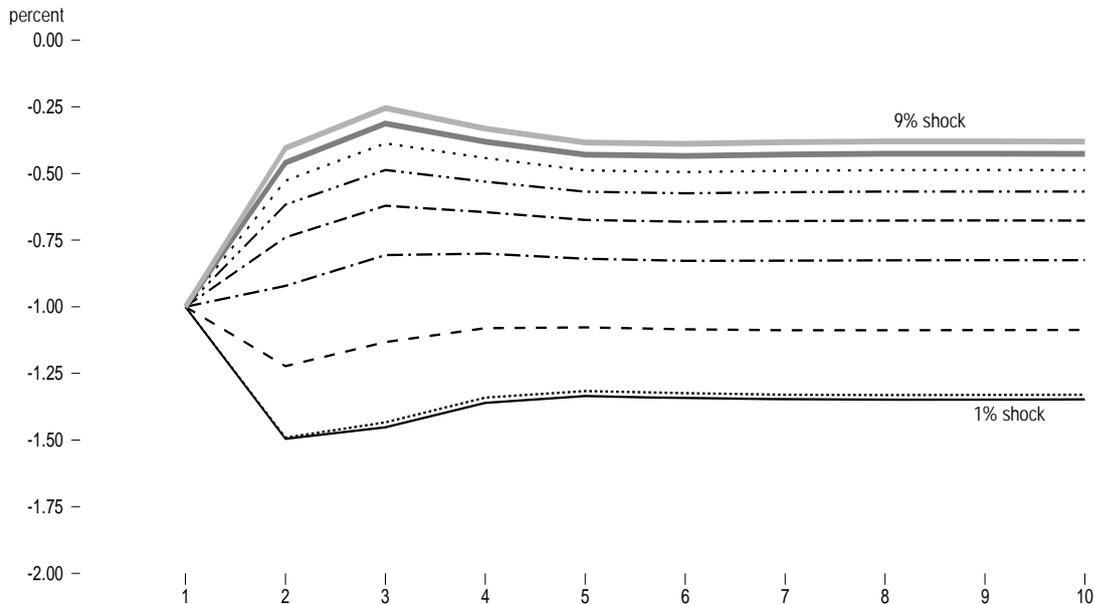
## Empirical Results

**Figure 4:**  
GDP Level: Deviation from Baseline



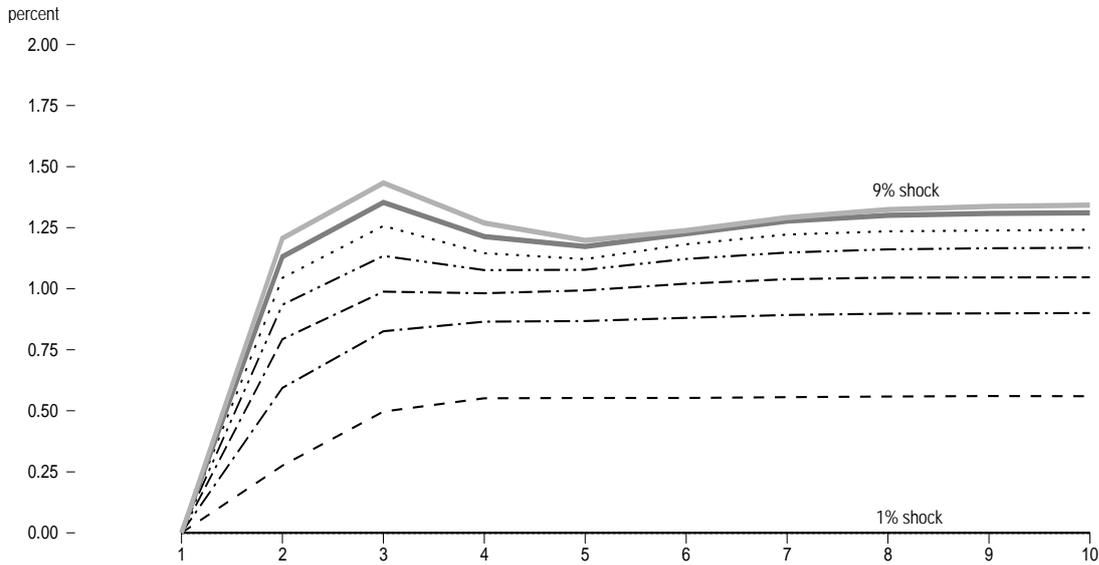
*Notes:* Impulse response functions are calculated as the difference to the baseline and are calculated as the mean over 1,000 bootstrap simulations. Impulse response functions are scaled by the absolute value of the respective shock.

**Figure 5:**  
GDP Level: Deviation from Baseline in the Case of a Recession



*Notes:* Impulse response functions are calculated as the difference to the baseline and are calculated as the mean over 1,000 bootstrap simulations. Impulse response functions are scaled by the absolute value of the respective shock.

Figure 6:  
GDP Level: Deviation between Recession and Crisis



Notes: Impulse response functions are calculated as the difference to the baseline and are calculated as the mean over 1,000 bootstrap simulations. Impulse response functions are scaled by the absolute value of the respective shock.

Similar patterns can be observed when comparing the recovery following a recession and a severe crisis (Figure 6). The recovery following an ordinary recession becomes relatively stronger with increasing size of the initial shock. Again, this effect diminishes with increasing size of the shock.

#### 4 Robustness Checks

To assess the stability of our results, we perform a number of robustness checks. In particular, we make sure that our results are not driven by the influence of some outliers in our sample of recessions. We also examine the role of our assumption regarding the issue of how closely a recession has to follow a banking crisis or a housing crisis on the time axis to classify that recession as been “associated” with these crises. In addition, we address the importance of non-modeled or “global” developments for our estimation results, and finally, we also control to what extend our results are driven by our method for identifying housing crises. We find that, while some results appear more fragile under alternative assumptions or modeling strategies, the overall findings remain largely unaffected.

Regarding the issue of outliers, a comparison of the recessions in our sample reveals that the recession in Finland beginning in 1991 and the recession in Switzerland beginning in 1975 were, indeed, exceptionally strong in terms of length and output loss. Since both recessions were preceded by a housing crisis, and the one in Finland was additionally followed by a banking crisis, one might argue that our results are driven mainly by these two cases. To check the robustness of our results with respect to these two potential outliers, we include dummy variables for each of the two recessions in the model. The estimation results show that the parameter value of the *cdr* term and the *t*-value increase dramatically (Table 2). Thus, the results of our baseline specifications (specification I and II) seem to be driven largely by these two recessions. Therefore, a strong bounceback effect following recessions is usually observable in the data, even when we do not account for further banking crises or housing

Table 2:  
Estimation Results for Outlier Analysis

	I	II	III	IV
$\Delta y_{t-1,i}$	0.50 (10.5)	0.51 (9.6)	0.52 (10.8)	0.52 (9.9)
$\Delta y_{t-2,i}$	-0.16 (3.8)	-0.20 (3.8)	-0.17 (4.0)	-0.20 (4.0)
$\Delta cdr_{t-1,i}$	0.82 (4.1)	0.88 (4.0)	1.47 (4.9)	1.53 (5.0)
$\Delta cdr_{t-2,i}$		-0.26 (1.2)		-0.53 (1.7)
$\Delta cdr_{t-1,i}^{bc}$			-1.18 (2.9)	-1.35 (3.1)
$\Delta cdr_{t-2,i}^{bc}$				0.66 (1.5)
$\Delta cdr_{t-1,i}^{hc}$			-0.81 (2.1)	-0.90 (2.2)
$\Delta cdr_{t-2,i}^{hc}$				0.46 (1.1)
$dum_{t-1}^{FN1991}$	-0.86 (4.1)	-1.3 (4.7)	-0.32 (1.0)	-0.56 (1.5)
$dum_{t-2}^{FN1991}$				0.24 (0.6)
$dum_{t-1}^{SW1975}$	-0.66 (3.0)	-0.62 (2.3)	-0.49 (1.5)	-0.37 (1.0)
$dum_{t-2}^{SW1975}$				-0.09 (0.2)
AIC	2150.2	2149.7	2144.7	2146.3
F-Test			0.36 / 0.04	0.37 / 0.12
Degrees of Freedom	523	520	521	516

Notes: *t*-values in parenthesis. First values of F-tests indicate the *p*-value of the hypothesis that the parameter values for the *cdr* terms and the banking crises interaction terms are identical. Second values refer to the housing crises interaction term *cdr* terms.  $dum^{FN1991}$  is a dummy variable for the starting year of the recession in Finland (1991).  $dum^{SW1975}$  is a dummy variable for the starting year of the recession in Switzerland (1975).

crises in our sample. The results of the extended specifications (III and IV), where we do account for the other crises, are still valid. The bounceback effect following an ordinary recession is much stronger than on average. When the recession was triggered by a severe crisis, the bounceback is much weaker or even vanishes completely.

According to our baseline specification, a recession is classified as associated with a severe crisis when it occurs within two years after the beginning of the crisis. To assess the robustness of our results with respect to this classification, we check the impact of alternative definitions on the estimation results. We re-estimate the model both under the assumption that the recession occurs within one year following the outbreak of a crisis and under the assumption that it occurs within three years. While the results are robust with regard to the time window of three years, they change if we allow only for a time window of one year. The recovery following an ordinary recession is estimated to be considerably weaker than in the baseline. Furthermore, it does not matter anymore whether the recession was triggered by a housing crisis or not. The assumption that the beginning of the recession and the crisis have to lie within a time window of one year seems to be rather restrictive and in contrast to the literature on business cycle effects of housing crises.<sup>8</sup> Therefore, the results of the baseline seem to be reasonable with respect to the construction of the interaction term.<sup>9</sup>

Furthermore, to verify that our results are not driven by non-modeled or “global” developments, we re-estimate the baseline specification using methods that allow to control for such developments in different ways. Specifically, we use the following procedures: estimation of the panel model with time fixed effects, incorporation of a variable that controls for global GDP growth, and estimation of a system of country-specific equations by seemingly unrelated equations. For all three methods the results are similar. The bounceback effect following an ordinary recession is estimated to be somewhat lower, but close to 100 percent of the former output loss. When the recession is triggered by a severe crisis, this effect is offset to a large degree or even completely. Therefore, the baseline results are qualitatively robust to the consideration of global business cycle dynamics.<sup>10</sup>

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<sup>8</sup> See IMF (2003), Ahearne et al. (2005), Claessens (2008), and IMF (2009), among others.

<sup>9</sup> A detailed robustness check regarding the interaction term can be found in Appendix A.

<sup>10</sup> A detailed robustness check regarding the influence of global business cycle dynamics can be found in Appendix B.

Finally, we control our results to determine whether they are driven by the ad-hoc method used to identify housing crises. In order to do so, we apply two alternative but related identification criteria proposed in the literature. If we follow the criterion of Ahearne et al. (2005), namely that all price peaks within a rolling window of nine years are presumed to be a housing crisis, the results virtually do not change. Alternatively, if we follow the criterion of the IMF (2003), namely that only those 25 percent of price peaks followed by the strongest price declines qualify as housing crises, the bounceback effect following ordinary recessions is estimated to be considerably smaller. Furthermore, housing crises do not seem to have any negative impact on recoveries. However, the latter result is driven mainly by the fact that the 1975 housing crisis in Switzerland is not captured by the applied criterion because it was not followed by a sufficiently large price decline. This leads us to conclude that the results are stable with respect to the method used to identify housing crises.<sup>11</sup>

## **5 Conclusion**

In this paper, we provide empirical evidence for industrialized countries that supports the hypothesis that ordinary recessions have at most small permanent negative effects on output, while recessions associated with banking crises or housing crises have strong permanent effects. Ordinary recessions are typically followed by a strong recovery that allows GDP to bounce back quickly close to its old level. This bounceback effect is nonlinear in the size of the negative shocks and becomes relatively stronger, the larger the shock is. This result remains valid when several robustness checks are applied. In contrast, when a recession is associated with a banking crisis or a housing crisis, the bounceback of GDP will almost or even completely be offset. Apparently, banking crises and housing crises involve longer-lasting structural adjustments requirements, possibly as a result to preceding overinvestment.

Our results are relevant in several respects. We confirm empirical results that were obtained in the literature concerning the effects of banking crises and housing crises by using nonparametric methods, in a parametric framework and we further provide a rationale for analyzing ordinary recessions and recessions associated with financial and other crises separately. In addition, we provide evidence in favor of nonlinear adjustment paths in the

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<sup>11</sup> A detailed robustness check regarding the identification of housing crises can be found in Appendix C.

## Conclusion

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sense of Beaudry and Koop (1993), at least after ordinary recessions. By implication, theoretical business cycle models should allow for nonlinear business cycle dynamics. Moreover, policy-makers should be aware that recovery paths following recessions can be quite different, necessitating different policy responses. Finally, since banking crises and housing crises can usually be recognized during or even before a recession, our results have practical implications for forecasting recessions and, in particular, recoveries.

## **Appendix: Robustness Check**

In the Appendix, we check the robustness of our results with respect to the construction of the interaction term, the influence of global business cycle developments, and the identification of housing crises.

### **A. Construction of the Interaction Term**

In the baseline scenario, we calculate the interaction terms for banking crises or housing crises based on the assumption that a recession is triggered by a crisis when the recession starts within a range of two years after the outbreak of the crisis. This assumption, even though plausible, is of course somehow arbitrary. Therefore, we control for different ranges, namely one (Lag 1) and three (Lag 3) years, between the outbreak of the crisis and the recession. If we choose the tighter criteria, allowing only for one year between crisis and recession, we lose eleven observations of recessions triggered by housing crises for the interaction term. Our sample for recessions triggered by banking crises loses only one observation. Allowing for three years between a recession and a crisis, the interaction terms stay substantially the same compared to the baseline scenario. One additional recession is allocated to the banking crisis interaction term. Three additional recessions are allocated to the housing crisis interaction term, while one observation is lost because of the recession that was additionally triggered by a banking crisis (with a housing crisis).

It turns out that the results using the one-year criteria change substantially (Table A1). Even though the baseline result is qualitatively still valid in case of banking crises, the parameter values are much smaller, indicating a much weaker recovery following ordinary recessions than estimated before. This can be explained by the shift of eleven recessions to the sample of ordinary recessions and these eleven recessions obviously exhibit a much weaker recovery than those in the original sample of ordinary recessions. In this scenario, it seems almost unimportant whether a recession was triggered by a housing crisis or not. We even find a positive but insignificant effect for the recovery. The specification that allows for a range of three years basically confirms the results of the baseline scenario.

## Appendix: Robustness Check

*Table A1:*  
Estimation Results for Different Interaction Terms

	lag 1		lag 2		lag 3	
	I	II	III	IV	V	VI
$\Delta y_{t-1,i}$	0.45 (10.0)	0.47 (9.2)	0.49 (10.8)	0.50 (9.8)	0.49 (10.8)	0.50 (9.8)
$\Delta y_{t-2,i}$	-0.16 (3.8)	-0.19 (4.0)	-0.17 (4.1)	-0.21 (4.3)	-0.18 (4.1)	-0.21 (4.4)
$\Delta cdr_{t-1,i}$	0.31 (2.6)	0.57 (3.4)	1.39 (4.7)	1.48 (4.9)	1.56 (5.0)	1.67 (5.2)
$\Delta cdr_{t-2,i}$		-0.39 (2.3)		-0.52 (1.7)		-0.63 (1.9)
$\Delta cdr_{t-1,i}^{bc}$	-0.36 (2.5)	-0.90 (4.1)	-1.42 (4.7)	-1.76 (5.4)	-1.59 (5.0)	-1.94 (5.7)
$\Delta cdr_{t-2,i}^{bc}$				0.82 (2.4)		0.91 (2.6)
$\Delta cdr_{t-1,i}^{hc}$	0.29 (0.8)	0.00 (0.0)	-1.18 (3.9)	-1.17 (3.6)	-1.37 (4.2)	-1.37 (4.0)
$\Delta cdr_{t-2,i}^{hc}$				0.36 (1.1)		0.48 (1.4)
AIC	2158.7	2153.4	2143.9	2142.2	2141.4	2139
F-Test Equivalence	0.63/0.10	0.95/0.11	0.79 / 0.08	0.92 / 0.24	0.79/0.09	0.92/0.26
Degrees of Freedom	523	520	523	520	523	520

*Notes:* *t*-values in parenthesis. First values of F-tests indicate the *p*-value of the hypothesis that the parameter values for the *cdr* terms and the banking crises interaction terms are identical. Second values refer to the housing crises interaction term *cdr* terms. Lag 1, lag 2, and lag 3 refer to specifications with different interactions terms, constructed using a maximum range of 1, 2 and 3, years, respectively, between an severe crisis and a recession.

Overall, our results are not totally robust to the specification of the interaction term. However, a range of only one year between crisis and recession seems to be rather short, because our specification of the starting year of a housing crisis (the year when house prices peak) implies that the recession has to occur in the first year in which house prices fall. In contrast, the literature points towards longer lasting lags between house price peaks and recessions.<sup>12</sup> Furthermore, the results indicate that those eight recessions that occur two years after the beginning of housing crises are followed by considerably weaker recoveries than the ordinary recession in our baseline scenario. This is another argument for differentiating between ordinary recessions and recessions that are triggered by housing crises. Therefore, our baseline results seem to be reasonable with regard to the specification of the interaction term.

<sup>12</sup> Compare Ahearne et al. (2005) and IMF (2003), among others.

## B. Accounting for Global Factors

Country-specific business cycle dynamics are certainly influenced by the global economy (Kose et al. 2003). Therefore, one might argue that our results are driven by global developments, for which we do not control in our relatively parsimonious model, rather than by domestic business cycle dynamics. We check the robustness of the results in this regard by modifying our model in three different ways: including time fixed effects, introducing a global GDP variable, and estimating the model using the seemingly unrelated regressions (SUR) method.

### B.1 Time Fixed Effects

One method to capture the influence of global developments on the results is to introduce time-fixed effects. However, as this would involve estimating another 33 parameters we do not use time fixed-effects in our baseline model.

Table A2:  
Estimation Results with Time-Fixed Effects

	I	II	III	IV
$\Delta y_{t-1,i}$	0.43 (9.7)	0.41 (7.6)	0.46 (9.7)	0.45 (8.3)
$\Delta y_{t-2,i}$	-0.16 (-3.6)	-0.07 (1.5)	-0.10 (2.1)	-0.11 (2.2)
$\Delta cdr_{t-1,i}$	0.11 (1.4)	0.07 (0.6)	0.89 (3.4)	0.89 (3.3)
$\Delta cdr_{t-2,i}$		0.08 (0.7)		-0.27 (1.0)
$\Delta cdr_{t-1,i}^{bc}$			-0.86 (3.3)	-1.12 (3.9)
$\Delta cdr_{t-2,i}^{bc}$				0.56 (1.9)
$\Delta cdr_{t-1,i}^{hc}$			-0.65 (2.5)	-0.67 (2.4)
$\Delta cdr_{t-2,i}^{hc}$				0.25 (0.9)
AIC	1960.9	1962.3	1952.3	1951.9
F-Test			0.77 / 0.02	0.46 / 0.06
Degrees of Freedom	492	491	490	487

Notes: *t*-values in parenthesis. First values of F-tests indicate the *p*-value of the hypothesis that the parameter values for the *cdr* terms and the banking crises interaction terms are identical. Second values refer to the housing crises interaction term *cdr* terms.

The introduction of time fixed-effects confirms the baseline results. While the parameter values and *t*-values are in general smaller, the results are qualitatively identical (Table A2).

Ordinary recessions are followed by a bounceback effect that is now below, but close to, 100 percent of the preceding output loss. Banking crises completely offset this effect. Pure housing crises, on the other hand, weaken the bounceback effect considerably, but not as strongly.

## B.2 Global GDP Variable

As a second method to control for the influence of the global business cycle dynamics, we include a global output variable in the baseline model. We calculate global output for each country individually as export weighted GDP growth of the other 15 countries in our panel.<sup>13</sup> Since the most important industrial countries are included in our sample, the calculated global variable should be a reasonable approximation of the global business cycle from the perspective of each individual country. Including the global variable  $\Delta y_t^*$  the model is defined as

$$\Phi(L)\Delta y_{t,i} = \alpha_i + [\Omega(L) - 1]cdr_{t,i} + [\Theta(L) - 1]cdr_{t,i}^{bc} + [\Pi(L) - 1]cdr_{t,i}^{hc} + \Gamma(L)\Delta y_t^* + \varepsilon_{t,i}. \quad (5)$$

We assume that each country is small compared to the world and allow therefore for contemporaneous effects of the global economy on domestic GDP growth.<sup>14</sup>

The global GDP variable is highly significant and improves the fit of the model considerably (Table A3). The qualitative results of the baseline model are confirmed. We can still observe a bounceback effect following an ordinary recession, even though the parameter values and  $t$ -values are smaller than in the baseline. Subsequent to a banking crisis, we do not observe a particularly fast recovery. Following a housing crisis, the bounceback effect is at least considerably weaker or even completely offset.

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<sup>13</sup> Export data were taken from the International Financial Statistics Database of the IMF.

<sup>14</sup> This assumption is obviously questionable for the United States, but reasonable for the other countries in our sample. The method of calculating the global term is inspired by a growing literature that uses export-weighted or, alternatively, trade-weighted foreign variables to account for global developments (see Aboysinghe and Forbes (2001) and Pesaran et al. (2004)).

Table A3:  
Estimation Results with Global Variables

	I	II	III	IV
$\Delta y_{t-1,i}$	0.47 (10.7)	0.46 (9.4)	0.50 (11.2)	0.49 (9.9)
$\Delta y_{t-2,i}$	-0,08 (2.4)	-0.08 (2.1)	-0.09 (2.7)	-0.11 (2.9)
$\Delta cdr_{t-1,i}$	0.12 (1.8)	0.10 (1.0)	0.77 (3.2)	0.82 (3.3)
$\Delta cdr_{t-2,i}$		0.02 (0.2)		-0.39 (1.6)
$\Delta cdr_{t-1,i}^{bc}$			-0.73 (3.0)	-0.99 (3.7)
$\Delta cdr_{t-2,i}^{bc}$				0.62 (2.3)
$\Delta cdr_{t-1,i}^{hc}$			-0.57 (2.3)	-0.61 (2.3)
$\Delta cdr_{t-2,i}^{hc}$				0.35 (1.3)
$\Delta y_{t,i}^*$	0.81 (17.0)	0.81 (17.0)	0.78 (16.4)	0.78 (16.3)
$\Delta y_{t-1,i}^*$	-0.33 (6.0)	-0.33 (5.9)	-0.32 (5.8)	-0.31 (5.5)
AIC	1925.0	1927.0	1919.5	1919.2
F-Test			0.68 / 0.05	0.46 / 0.11
Degrees of Freedom	523	522	521	518

Notes: *t*-values in parenthesis. First values of F-tests indicate the *p*-value of the hypothesis that the parameter values for the *cdr* terms and the banking crises interaction terms are identical. Second values refer to the housing crises interaction term *cdr* terms.

### B.3 Seemingly Unrelated Regression

If global business cycle dynamics are relevant in our model the neglect of them directly translates into cross correlation of the error terms if we estimate our model country wise ordinary least squares. This would lead to inefficient estimation results. A direct way to address this problem is to estimate the system of equations using the seemingly unrelated regression (SUR) method which explicitly accounts for the cross correlation in the error terms. A disadvantage of SUR is that we have to estimate the covariance matrix and therefore additional  $(16 \cdot 15) / 2 = 120$  parameters. For a dataset containing 592 observations this is highly demanding and could lead to imprecise parameter estimates. Even though SUR seems to be an appropriate method for our estimation exercise in general, we refrain for this reason from using SUR for the baseline results. To test if there is still a common nonlinear effect concerning the recovery following a recession, we restrict the parameters of the *cdr* terms and the interaction terms such that they are equal across all the countries in our panel. Further, to

make the results as comparable as possible to the panel estimation results, we restrict also the autoregressive terms such that they are equal across countries.<sup>15</sup>

The baseline results are qualitatively confirmed by SUR estimation. The bounceback effect following ordinary recessions is estimated to be weaker than in the baseline, but with a parameter value of 0.88 in the specification with one lag this is still high (Table A4). When the recession is triggered by a crisis, the bounceback effect does not occur at all (banking crisis), or is at least considerably weaker (housing crisis).

Table A4:  
Seemingly Unrelated Regression Estimation Results

	I	II	III	IV
$\Delta y_{t-1,i}$	0.40 (10.2)	0.40 (9.6)	0.41 (10.6)	0.41 (10.4)
$\Delta y_{t-2,i}$	-0.14 (3.8)	-0.14 (3.5)	-0.13 (3.5)	-0.16 (4.4)
$\Delta cdr_{t-1,i}$	0.05 (1.0)	-0.02 (0.2)	0.88 (6.2)	0.95 (6.5)
$\Delta cdr_{t-2,i}$		0.08 (1.1)		-0.55 (3.8)
$\Delta cdr_{t-1,i}^{bc}$			-0.95 (6.2)	-1.33 (8.3)
$\Delta cdr_{t-2,i}^{bc}$				0.95 (5.9)
$\Delta cdr_{t-1,i}^{hc}$			-0.75 (5.1)	-0.88 (6.1)
$\Delta cdr_{t-2,i}^{hc}$				0.54 (3.3)

Notes: *t*-values in parenthesis.

### C. Alternative Definitions of Housing Crises

In the baseline scenario, we define the starting year of a housing crisis as the peak of real house prices within a rolling window of nine years followed by a price decline of at least 7.5 percent within the subsequent four years. Even though this method provides reasonable and stable results, it is rather ad-hoc. Therefore, we test the robustness of the results with respect to two alternative but related identification criteria applied in the literature. As a first modification, we relax our identification criterion to include all price peaks that occur within a rolling window of nine years. This is in accordance with Ahearne et al. (2005), who use a similar criterion for quarterly data. Using this criterion we identify 34 housing crises in our sample. Since 29 of these 34 housing crises were already identified as crises in our baseline

<sup>15</sup> The results are qualitatively the same if we do not restrict the autoregressive terms such that they are equal.

scenario the results are rather stable with respect to this modification (Table A5). As a second modification, according to the IMF (2003), we define only the 25 percent most severe house price declines following one of the 34 identified price peaks as a housing crisis.<sup>16</sup> Considering only the most severe housing crises changes the results drastically. The bounceback effect following ordinary recessions is estimated to be much weaker than in the baseline.

Table A5:  
Estimation Results for Alternative Housing Crises Identification Criteria

	Baseline		All peaks		Most severe	
	I	II	III	IV	V	VI
$\Delta y_{t-1,i}$	0.49 (10.8)	0.50 (9.8)	0.49 (10.7)	0.50 (9.7)	0.44 (9.9)	0.48 (9.3)
$\Delta y_{t-2,i}$	-0.17 (4.1)	-0.21 (4.3)	-0.17 (4.1)	-0.21 (4.3)	-0.16 (3.8)	-0.21 (4.4)
$\Delta cdr_{t-1,i}$	1.39 (4.7)	1.48 (4.9)	1.38 (4.7)	1.47 (4.8)	0.31 (2.6)	0.58 (3.5)
$\Delta cdr_{t-2,i}$		-0.52 (1.7)		-0.52 (1.7)		-0.44 (2.5)
$\Delta cdr_{t-1,i}^{bc}$	-1.42 (4.7)	-1.76 (5.4)	-1.41 (4.7)	-1.75 (5.4)	-0.36 (2.5)	-0.90 (4.2)
$\Delta cdr_{t-2,i}^{bc}$		0.82 (2.4)		0.81 (2.4)		0.76 (3.49)
$\Delta cdr_{t-1,i}^{hc}$	-1.18 (3.9)	-1.17 (3.6)	-1.17 (3.9)	-1.16 (3.6)	0.54 (1.2)	0.88 (1.9)
$\Delta cdr_{t-2,i}^{hc}$		0.36 (1.1)		0.36 (1.1)		0.17 (0.4)
AIC	2143.9	2142.2	2144.1	2142.5	2158.1	2152.0
F-Test	0.79 / 0.08	0.92 / 0.24	0.78 / 0.07	0.92 / 0.05	0.60 / 0.06	0.97 / 0.07
Degrees of Freedom	523	520	523	520	523	520

Notes: *t*-values in parenthesis. First values of F-tests indicate the *p*-value of the hypothesis that the parameter values for the *cdr* terms and the banking crises interaction terms are identical. Second values refer to the housing crises interaction term *cdr* terms.

For the specification with one lag, the bounceback effect is only about a quarter of the size obtained for the baseline. In the case of a banking crisis the bounceback effect still vanishes completely. In contrast, in case of a housing crisis the parameter values of the *cdr* terms even change their signs, signalling an even stronger bounceback effect, but are barely significant. It follows that the most severe housing crises in terms of house price decline need not be necessarily those with the weakest recoveries. The result of a moderate bounceback effect in the specification with the most severe housing crises is largely driven by the fact that the housing crisis in Switzerland that began in 1975 cannot be considered as one of the most

<sup>16</sup> Each of the remaining 9 housing crises was accompanied by a decline in real house prices of at least 32.5 percent.

severe housing crises in terms of price declines. If we include this crisis as an additional interaction *cdr* term in the model, the bounceback effect is estimated to be 100 percent of the former output loss.

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