Growth Dynamics: The Myth of Economic Recovery - Comment

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Abstract

This comment highlights different ways of coding crisis episodes in Cerra and Saxena (2008) (CS) and shows that some of their main results are crucially dependent on this coding. A correct coding of civil war reveals that it leads to an average loss in output of 18 percent. This makes civil wars more devastating than all other crisis studied by CS. In a second step this article proposes a way of coding crisis so that different crisis lengths can be distinguished. The resulting analysis suggests that the average output response to the a crisis shock hides stronger declines and some recovery by mixing the output response to shorter and longer crisis. Data on crisis starts alone cannot identify recovery if crisis episodes are heterogenous in length.

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In their article "Growth Dynamics: The Myth of Economic Recovery" Valerie Cerra and Sweta Chaman Saxena (CS) estimate the growth reaction to crisis episodes. They study four kinds of crisis: currency crisis, banking crisis, civil wars and stronger executive power. To study the effect of crisis on output they estimate growth regressions (assuming an AR(4) process) into which they insert dummies to indicate crisis years. They then use the estimated coefficients to calculate impulse response functions to visualize the output response to crisis. Their article concludes that crisis outbreak is followed by a persistent negative output response, except for civil wars who feature some recovery of output.

The literature has taken their interpretation of the effects of crisis face-value. Blattmann and Miguel (2010), for example, write in their literature summary on the economic effects of civil wars: *"Indeed, a recent study of the output response to alternative crises—including currency crises, banking crises, civil war, and sudden shifts in executive power—finds that while civil wars cause the steepest short-run fall in output (six percent on average), only in the case of civil war does output rebound quickly, recovering half of the fall within a few years, while output drops are more persistent for financial crises (Cerra and Saxena 2008)."*[1]

This note discusses an important methodological shortcoming in CS that leads to this conclusion. We highlight the fact that CS code civil wars differently than all other crisis in their study. This leads to a drastic misrepresentation of the average output responses following a civil war. If we code civil wars as the other crisis types we find that civil wars lead to an average output collapse of more than 17 percent. This makes them the most devastating crisis studied by CS. In addition, the recovery, highlighted by CS and in the quote above, disappears.

This absence of recovery after civil war stands in some contrast to more detailed studies in the conflict literature. The second aim of the comment is to resolve this puzzle. We show that if crisis episodes are highly persistent (as is the case for both civil wars and banking crisis) then the resulting impulse response functions mix the response to recovery of shorter episodes with the response to longer, ongoing crisis episodes. This can mean that existing recovery becomes invisible in the average response. Quite intuitively, if output recovery is to be studied, the study needs to use some data on the timing of this recovery.

We suggest a way to use the existing data to separate crisis from recovery and apply it to civil wars. For comparison, we also apply the methodology to the more debatable banking crisis data. We conclude that, firstly, there are striking parallels in the shape of the growth response to civil wars and banking crisis. Our results suggest that the overall average response to the start of crisis hides stronger declines followed by some recovery. Secondly, both in severity and persistence civil war shocks are worse for output than banking crisis.

This note is structured as follows. Section 1 briefly presents the methodology and the two ways of coding crisis used by CS. Section 2 shows that the results in CS are driven by differences in coding crisis. The way CS represent civil wars leads to a misrepresentation of their impact. In sections 3 and 4 we discuss

[1] Blattman and Miguel (2010), p. 39.

the role of crisis length and show that disregarding it can mean that recoveries become invisible. Section 5 concludes.

1 The Methodology

In their study of crisis episodes CS gather data on four types of crisis in order to insert them into the following growth regression

$$g_{it} = a_i + \sum_{j=1}^{4} \beta_j g_{i,t-j} + \sum_{s=0}^{4} \delta_s D_{i,t-s} + \varepsilon_{it} \tag{1}$$

where g_{it} is the real GDP per capita growth rate and a_i are country fixed effects. The crisis episodes enter through a panel of dummies $D_{i,t} = \{0, 1\}$. CS use the estimated coefficients β_j and δ_s to construct impulse response functions.

For reasons that will become apparent below the main focus here is on banking crisis and civil wars. CS use banking crisis data from Gerard Caprio and Daniela Klingebiel (2003) but only code the first year of systemic crisis in this dataset as $D_{i,t} = 1$ and all other years as $D_{i,t} = 0$. In what follows we will call this way of coding crisis the crisis *start* coding.

The data on civil wars are taken from Meredith Sarkees (2000) Correlates of War Intra-State War Data. CS code all civil war years with $D_{i,t} = 1$ and not just the start years as in banking crisis. We call this way of coding the crisis *year* coding.

We reproduce some of the output responses in CS in appendix A to ensure that we re-created their methodology correctly.

2 Misrepresentation of Civil Wars

As a robustness check of the findings in CS we run two parallel analysis for both banking crisis and civil wars. Figure 1a shows the output response to a civil war start on the left and the output response to a banking crisis start on the right.[2] CS report the right graph in their figure 4. Figure 1b shows the impulse response to a civil war year on the left and the response to a banking crisis year on the right. CS report the left graph in their figure 6.

Clearly, the shape of the impulse response function is directly a result of the way that crisis are coded. The start coding in figure 1a shows a strong, persistent decline for both civil war and banking crisis. If every crisis year is coded $D = 1$ (figure 1b) the decline is smaller and output recovers somewhat.

This effect of the coding is never discussed in CS. The authors compare the output response of a banking crisis start (figure 1a) to the output response of a civil war year (figure 1b) and conclude that *"In contrast to the extreme*

[2] The dashed lines report one standard deviation error bands computed from 1000 Monte Carlo simulations. The simulation uses the variance-covariance matrix of the estimated coefficients in equation (1) and their asymptotically normal distribution.

persistence of output loss following financial crises, output partially rebounds from a civil war (Figure 6)."[3] Given the information put forward in figures 1a and 1b this conclusion seems dubious.

In order to understand how the two ways of coding crisis affect the results it helps to illustrate the estimated coefficients in a boiled down version of equation (1).[4] Disregarding the AR growth process and country fixed effects we can write equation (1)

$$g_{it} = \sum_{s=0}^{4} \delta_s D_{i,t-s} + \varepsilon_{it}. \tag{2}$$

Denote $\bar{x}_\tau$ the average growth rate in year τ of crisis, i.e. $\bar{x}_1$ is the average growth rate in the first year of crisis. When the start of crisis is coded 1 the OLS estimate of the coefficients δ, $\hat{\delta}$, is given by[5]

$$\left(\hat{\delta}_0, \hat{\delta}_1, \hat{\delta}_2, \hat{\delta}_3, \hat{\delta}_4\right) = \left(\bar{x}_1, \bar{x}_2, \bar{x}_3, \bar{x}_4, \bar{x}_5\right). \tag{3}$$

Equation (3) shows that the OLS estimate $\hat{\delta}$ simply reflects the average growth rates in the years following crisis start. The coefficient on the third lag, $\hat{\delta}_3$, for example, captures average growht in the fourth year of crisis. If sufficient lags are included in the regression the OLS estimate will therefore be able to capture the growth reaction to crisis - including recovery. Assume, for example, that crisis are three years long. Then $\hat{\delta}_0, \hat{\delta}_1$ and $\hat{\delta}_2$ capture the average growth in the three crisis years while $\hat{\delta}_3$ and $\hat{\delta}_4$ capture the average growth in the first two years of recovery. This suggests that the output responses in figure 1a indeed reflect the average growth response to a crisis start.

The start coding is not only intuitively appealing but is also in line with the existing literature. Christina Romer and David Romer (2010), for example, use the same method to calculate the impact of exogenous tax shocks on growth. A related literature uses the Ramey-Shapiro "war dates", episodes of military buildups in the US, in a similar way. Valerie Ramey (2011), for example, runs a VAR to analyze the response of the system to a dummy which takes a value of unity at the start of each war date episode.

The intuitive appeal of the start coding used for most crisis types in CS is not shared by the year coding used for civil wars. The output responses in figure 1b display a mixture of growth responses at various stages of crisis and mix them with the growth response after crisis.[6] In addition, the output responses presented in CS show the reaction to one year of civil war whereas civil wars in the data typically last several years. A more accurate image of the impact of civil war is therefore the response to more than one year of civil war in a row. Figure 2 shows the output response to a civil war of median length (five years). The graph uses the same estimates as figure 1b but simulates the response to

[3] Cerra and Saxena (2008), p. 442.

[4] The author thanks an anonymous referee for suggesting this way of illustrating the issue.

[5] For derivations see the web-appendix B.

[6] We show in the appendix B that the respective estimates in equation (2) cannot be interpreted.

Figure 1a: Output response to civil war start (left) and banking crisis start (right)

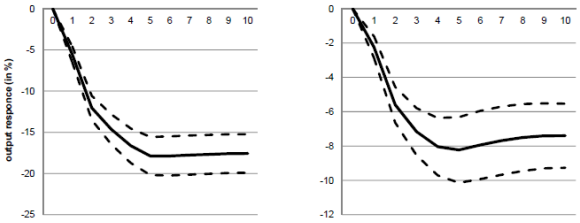
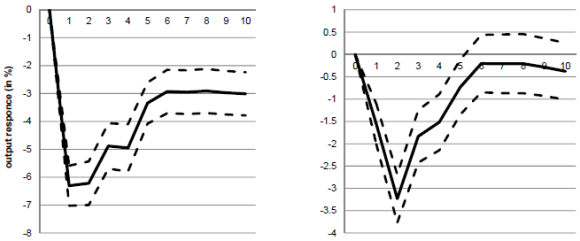
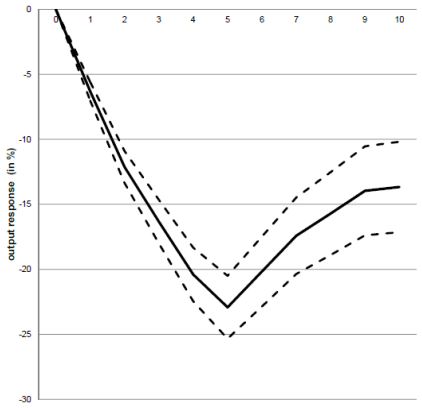


Figure 1b: Output response to civil war year (left) and banking crisis year (right)



five instead of one year of civil war. Output contracts by about 23 percent in year 5 and recovers somewhat thereafter. This makes the output response to five years of civil war similar in magnitude to the output response to a civil war start in figure 1a.

Figure 2: Output response to five years of civil war



In conclusion, the output responses in figure 1a correctly represent the average output response to banking crisis and civil war. The output responses in figure 1b do not represent the data correctly. This implies that the output responses for civil war drawn in CS lead to drastic misinterpretations.

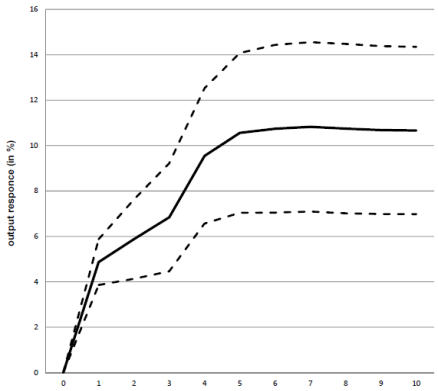
The magnitude of this misrepresentation can be seen when comparing the responses in figures 1a and 1b. Figure 1b (figure 6 in CS) suggests a 3 percent

impact of civil war reached after recovery. The correct magnitude provided by figure 1a suggests that output declines by about 18 percent. This makes civil wars the most devastating crisis studied by CS. Recovery after civil war is absent in figure 1a.

3 Mixing Recovery with Crisis

As is clear from the title of their paper, CS are particularly interested in identifying growth recoveries after crisis. In the case of civil wars this interest finds parallels in recent studies of asset price reactions to the cessation of violence.[7] These studies typically analyze the impact of the end of violence and not the start. Figure 3 depicts the output response to the end of civil war in the data used by CS.[8] The regression underlying the figure follows equation (1) except that the dummy variable now codes only the first year at the end of civil war as $D = 1$. Figure 3 suggests that output booms after civil wars end. Why is this abnormal growth after civil war not visible in figure 1a?

Figure 3: Output response to start of recovery after civil war



Conceptually it helps to think of crisis start and end as two separate shocks. The methodology used in CS attempts to identify the effect of the second shock (crisis end) by tracking the long term reaction to the first shock (crisis start). We illustrated in the previous section that this works well if all crisis have the same length - the timing of the end of crisis is perfectly explained by its start. However, if crisis vary in length this link breaks down and the timing of crisis ends is less well explained by crisis starts.

Table 1 provides summary statistics for the length of banking crisis, civil wars and currency crisis. The table reports the mean length of crisis, the standard

[7] See, for example, Tim Besley and Hannes Mueller (forthcoming); Massimo Guidolin and Eliana La Ferrara (2007); and Alberto Abadie and Javier Gardeazabal (2003).

[8] The equivalent analysis for banking crisis shows similar results.

deviation of the length and the persistence of crisis in the respective sample.[9] Banking crisis last on average 4.5 years while civil wars last on average 5.7 years. Standard deviations of 4.1 and 5.5 respectively indicate that the length of banking crisis and civil war varies considerably within the sample.[10] Currency crisis are much shorter and vary less in length. This means that the original CS methodology should capture recoveries from currency crisis reasonably well. In what follows we therefore focus our discussion on banking crisis and civil wars and disregard currency crisis.

Table 1: Summary Stastics for Crisis Episodes

Variable	Number of Crisis	Mean Length	Std. Dev. of Length	Minimum Length	Maximum Length	Crisis Persistence*
Banking Crisis	93	4.484	4.085	1	24	0.777
Civil War	60	5.667	5.489	1	21	0.824
Currency Crisis	832	1.501	0.936	1	10	0.334

*Crisis Persistence is the probability that a crisis year is followed by another crisis year: (Mean Length - 1) / Mean Length

The persistence parameter in the last column in table 1 provides a useful summary of the data on crisis length. Crisis persistence is the likelihood that a crisis year is followed by another crisis year. Put differently, from the 93 banking crisis in the sample, roughly 77.7 percent last a second year. Of those banking crisis that last two years roughly 77.7 percent last a third year, and so on. Figure 4 shows the distribution of crisis lengths for civil war and banking crisis in the top row. The graph for banking crisis on the right shows, for example, that about 70 crisis last at least two years, about 55 crisis last three years and over 10 crisis last at least ten years. The bottom graphs in figure 4 illustrate that both the length distribution of banking crisis and the length distribution of civil wars is well approximated by a data-generating process with the respective persistence from table 1. The solid line in the bottom left corner, for example, shows the number of "surviving" civil wars if a share of 18 percent stops every year. The fact that this percentage is low and relatively constant has important implications for the shape of the output response shown in figure 1a.

As figure 4 demonstrates the data-generating process for crisis length can be approximated by a constant persistence p. The OLS estimate derived from equation (2) can then be approximated by[11]

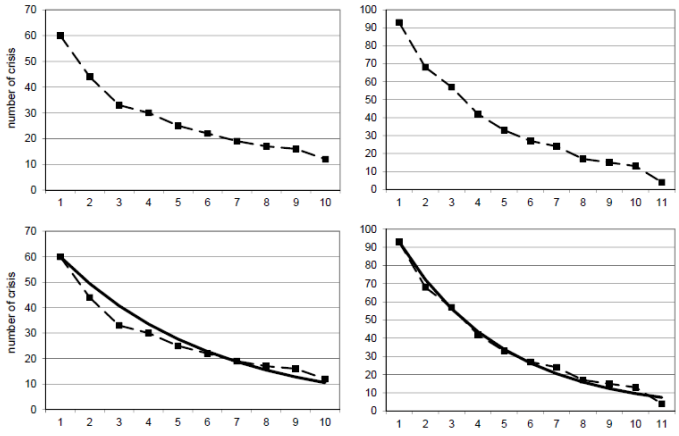
$$\hat{\delta} \approx \begin{pmatrix} \bar{c}_1 \\ p\bar{c}_2 + (1-p)\,\bar{y}_1 \\ p^2\bar{c}_3 + (1-p)\,[p\bar{y}_1 + \bar{y}_2] \\ p^3\bar{c}_4 + (1-p)\left[p^2\bar{y}_1 + p\bar{y}_2 + \bar{y}_3\right] \\ p^4\bar{c}_5 + (1-p)\left[p^3\bar{y}_1 + p^2\bar{y}_2 + p\bar{y}_3 + \bar{y}_4\right] \end{pmatrix} \tag{4}$$

[9] We only report crisis that have a recovery within the sample. Results do not change if crisis that run to the end of the sample are included.

[10] The discussion of banking crisis data in Carmen Reinhart and Kenneth Rogoff (2009) leads to the same conclusion.

[11] See web-appendix C for the derivation.

*Figure 4: Distribution of crisis length for civil war (left) and banking crisis (right)**



*Top row shows number of crisis that have at least the length indicated on the x-axis. Bottom row adds approximation (solid line) of crisis distribution if civil wars and banking crisis length distribution was generated by a process with persistences given in table 1.

where $\bar{c}_\kappa$ denotes the average growth rate in crisis year κ (average over those crisis that last at least κ years) while $\bar{y}_\nu$ denotes the average growth in year ν following the end of crisis.[12] For example, $\bar{c}_2$ denotes the average growth in the second year of crisis for those crisis that last at least two years. We expect the $\bar{c}_\kappa$ to be negative while the $\bar{y}_\nu$ are positive if recovery exists. Note that equation (3) still holds. Equation (4) only provides the approximate composition of the average growth rates, $\bar{x}_\tau$.

Equation (4) demonstrates that the average growth following the start of crisis (except for the first year) is a mixture of both growth in crisis years, $\bar{c}_\kappa$, and recovery years, $\bar{y}_\nu$. In other words, the OLS estimates with hetereogenous crisis length provide the average response but they do not provide estimates of recovery growth, $\bar{y}_\nu$.

If we extrapolate this analysis to the findings in CS it implies that the shape of the calculated output responses should not be taken too literally. In particular, if recovery is weak and short then it can become invisible in the overall average response, $\bar{x}_\tau$. If we assume that recovery lasts only one year then we have $\bar{y}_2 = \bar{y}_3 = \bar{y}_4 = 0$ and the OLS estimate in equation (4) is

$$\hat{\delta} \approx \begin{pmatrix} \bar{c}_1 \\ 1\left[p\bar{c}_2 + (1-p)\,\bar{y}_1\right] \\ p\left[p\bar{c}_3 + (1-p)\,\bar{y}_1\right] \\ p^2\left[p\bar{c}_4 + (1-p)\,\bar{y}_1\right] \\ p^3\left[p\bar{c}_5 + (1-p)\,\bar{y}_1\right] \end{pmatrix}.$$

The terms before the square bracket capture the share of economies that are still affected by crisis or recovery. This share is falling constantly leading to less

[12] For simplicity, we assume $\bar{y}_\nu$ to be independant of crisis length.

and less impact of the growth averages $\bar{c}_\kappa$ and $\bar{y}_\nu$ on the estimated coefficients $\hat{\delta}$. In addition, the estimated coefficients (except for $\hat{\delta}_0$) capture a constant share p of persisting crisis and only a share $1-p$ of economies in recovery. If the output response to civil war in figure 1a was based on these estimates it would show a mixture of 82 percent crisis and 18 percent recovery for every year past the first year. Even if the $\bar{y}_\nu$ were positive the output response would then not bend upwards notably.

All this suggests that while the figures in 1a are a good way to visualize the average response, this average could be hiding significant recovery. The regression in equation (1) does not distinguish between the direct impact that the start of a crisis has on future growth and its indirect impact through persisting crisis. The coefficients estimated with the lags of crisis start therefore capture a mixture of the response to crisis and recovery. In the following section we provide a different way to look at the data that closely follows the methodology used by CS but separates crisis and recovery periods.

4 Separating Crisis and Recovery

In order to resolve the discrepancy between figure 1a and figure 3 we need to include information on crisis starts and ends into the same regression. Before we do so it is important to keep the limitations posed by the data in mind. Firstly, there is considerable debate with regard to what constitutes both a civil war and a banking crisis.[13] Data on crisis length therefore contains measurement error. In addition, both banking crisis and civil wars could be endogenous to economic growth. In the case of banking crisis this is most obvious. Growth slowdowns can cause banking crisis while recoveries can help banks restructure. In order to focus on the methodological issue we will proceed as if both civil wars and banking crisis were correctly measured and exogenous. However, any interpretation of our results should keep these issues in mind.

A simple way to separate crisis and recovery episodes that stays true to the "start" coding in CS is to create separate sets of dummy variables for crisis years ($D_{i,\kappa}$) and recovery years ($D_{i,\nu}$). Each year of crisis and recovery receives a separate dummy. Table 2 illustrates the construction of the two sets of dummies in the example of a crisis of two years. We use the dummies created in this way in a regression of the form

$$g_{it} = a_i + \sum_{j=1}^{4} \beta_j g_{i,t-j} + \sum_{\kappa=1}^{K} \delta_\kappa D_{i,\kappa} + \sum_{\nu=1}^{V} \delta_\nu D_{i,\nu} + \varepsilon_{it} \tag{5}$$

where K indicates the maximum length of crisis in the sample while V indicates the recovery period. This regression imitates the crisis start coding in equation

[13] For civil wars see, for example, the discussion in Nicholas Sambanis (2004). For banking crisis there are considerable discrepencies in the timings provided by Caprio and Klingebiel (2003) compared to the ones in Asli Demirgüç-Kunt and Enrica Detragiache (2005), for example.

(1) with the only difference that now economies in recovery are separated from economies in crisis.

Table 2: Seperating Crisis and Recovery

	crisis dummies			recovery dummies		
crisis data	year 1	year 2	year 3	year 1	year 2	year 3
0	0	0	0	0	0	0
0	0	0	0	0	0	0
1	1	0	0	0	0	0
1	0	1	0	0	0	0
0	0	0	0	1	0	0
0	0	0	0	0	1	0
0	0	0	0	0	0	1

A main advantage of introducing crisis length is that it provides a natural way to capture heterogeneity in the crisis data. Figure 5 visualizes the average output response to crisis of various lengths. The top row shows the output response to civil wars of length three, five and eight years.[14] The bottom row shows the responses to banking crisis of three, five and eight years for comparison.

Clearly, longer crisis hurt the economy more. Figure 5 suggests that a civil war that lasts eight years shrinks the economy by about 30 percent, civil war of three years by about 12 percent. At all lengths civil wars are worse for the economy than banking crisis. In addition, it should be kept in mind that civil wars last longer. The median civil war lasts 5 years while the median banking crisis lasts only 4 years.

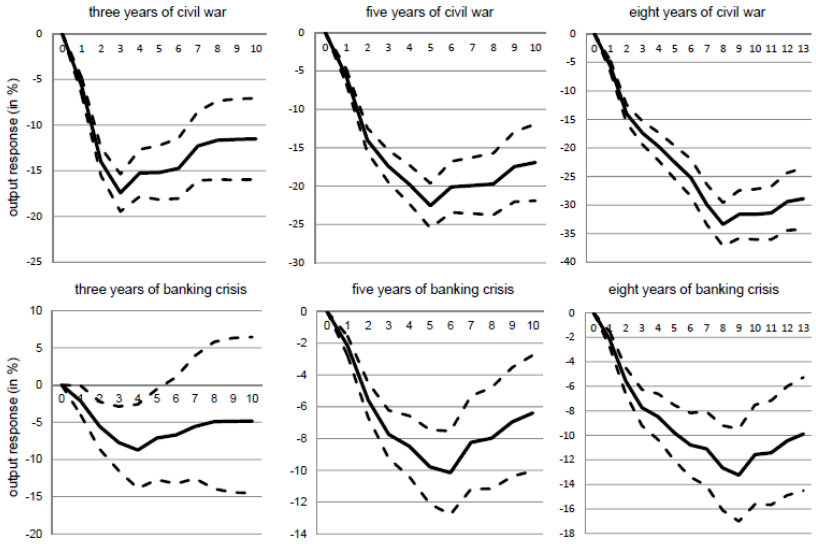
The output loss caused by the median civil war (5 years) is 17 percent which is very close to the 17.5 percent output loss found in figure 1a for civil war starts. However, our method suggests that the 17 percent loss is reached after a phase of much higher losses of about 23 percent followed by a 6 percent recovery. Figure 1a mixes crisis collapse and recovery and therefore misses this aspect of the output response. To use the intuition provided by equation (2), our method goes one step in separating growth rates in recovery ($\bar{y}_\nu$) from the overall crisis reaction ($\bar{x}_\tau$) which lowers the point estimate of crisis growth ($\bar{c}_\kappa < \bar{x}_\tau$).

The output response to banking crisis changes its shape in exactly the same manner as the output response to civil war. This suggests that the banking crisis response in figure 1a is affected by the same issues. Its shape should therefore not be taken too literally, i.e. as hard evidence for the absence of (some) recovery. In any case, there is clearly no evidence that the economy recovers more from civil wars than from banking crisis. The methodological issues in CS lead to a significant misinterpretation of the output response to civil wars compared to banking crisis.

An interesting question in the context the existing data limitations is whether crisis length is a meaningful determinant of the heterogeneity in crisis responses.

[14] The assumption underlying the regression in equation (4) is that recovery growth is independant of crisis length. In order to minimize the error this introduces we do not calculate the output responses to crisis shorter than three years.

*Figure 5: Output response to civil war (top row) and banking crisis (bottom row) of varying length**



*The graphs display the output response calculated from an estimation that follows equation (4). The regression includes 21 crisis year dummies for civil war and 24 crisis year dummies for banking crisis. The recovery period was assumed to be five years long.

We find that, holding length constant, our output responses to banking crisis vary less than the responses reported in CS.[15] However, a clear definition and measurement of banking crisis and their exogeneity needs to be established first before the heterogeneity in banking crisis length can be used with some confidence.

5 Conclusion

In this note we re-run the analysis in Cerra and Saxena (2008) for banking crisis and civil wars and show that their conclusions about these two sorts of crisis are entirely driven by inconsistent ways of coding them. If we swap the coding, i.e. we code civil wars like CS code banking crisis and banking crisis like CS code civil wars we see that first, civil war starts do not feature a recovery and, secondly, banking crisis years appear to feature a strong recovery.

We argue here that only the output response to crisis start delivers a correct representation of the impact of crisis. Adopting this methodology for civil wars we find that civil wars lead to an average output collapse of more than 17 percent. This makes civil wars the most devastating crisis studied by CS.

Our analysis of crisis length shows that both banking crisis and civil wars are highly heterogeneous in length. The output responses calculated with the start coding disregard this heterogeneity and mix the response to short and long crisis. We show that, depending on the distribution of crisis length, this mixture

[15] Some of the findings are reported in the web appendix D.

can make crisis appear less devastating and recovery disappear. We develop a methodology to separate crisis from recovery and find our theoretical results confirmed in the civil war data.

We conclude that data on crisis starts alone cannot identify recovery if crisis episodes are heterogenous in length. With the available data it appears impossible to conclude anything definite on the extent of recovery after banking crisis. However, if we use the available data on banking crisis length we find that recovery after banking crisis is not weaker than recovery after civil war.

Our comment applies less to the two other sorts of crisis analyzed by CS. Their currency crisis data features few episodes that stretch over many years in a row. Instead, affected countries appear to slip in and out of currency crisis for decades. Similarly, shifts in executive power feature, by construction, few tangible episodes. However, here our conceptual criticism applies fully given that studies like Torsten Persson and Guido Tabellini (2009) postulate economic effects to come through the persistence of different political regimes not the change in regime per se. One of their main messages, that heterogeneity between countries should be taken seriously, is illustrated by the vastly different impulse response functions found by CS for different sub-samples.

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