

Growth Dynamics: The Myth of Economic Recovery - Comment
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Online Appendix

A Reproduction of Cerra and Saxena

In order to reproduce the findings by CS we estimate equation (1) with added country fixed effects and for different sub-samples. To be sure that we reproduce their methodology correctly we estimate the model for the full sample and three different income sub-samples (upper middle income, lower middle income and lower income) all taken from their data. Tables A1 and A2 present the results for our reproduction of their banking crisis and civil war regressions.

Table A1: Banking Crisis Regression Results

VARIABLES	Full Sample (1) growth	Upper middle income (2) growth	Lower middle income (3) growth	Lower income (4) growth
growth (L1)	0.296*** (0.0201)	0.377*** (0.0499)	0.366*** (0.0389)	0.264*** (0.0332)
growth (L2)	0.0140 (0.0205)	-0.114** (0.0476)	0.132*** (0.0408)	0.0284 (0.0339)
growth (L3)	0.0446** (0.0196)	-0.0130 (0.0459)	-0.0873** (0.0369)	0.0989*** (0.0332)
growth (L4)	-0.135*** (0.0184)	-0.101*** (0.0369)	-0.0906*** (0.0343)	-0.163*** (0.0329)
bankcrisis start	-2.236*** (0.616)	-5.478*** (1.220)	-1.422 (0.974)	-0.685 (1.227)
bankcrisis start (L1)	-2.776*** (0.605)	-3.862*** (1.273)	-2.184** (0.954)	-2.100* (1.210)
bankcrisis start (L2)	-0.606 (0.601)	-0.322 (1.244)	0.201 (0.952)	-1.143 (1.198)
bankcrisis start (L3)	-0.307 (0.596)	1.460 (1.234)	-0.139 (0.945)	-2.074* (1.195)
bankcrisis start (L4)	-0.0528 (0.597)	-1.734 (1.196)	1.237 (0.965)	-0.399 (1.193)
Observations	2539	396	701	917
R-squared	0.131	0.247	0.203	0.114
Number of countries	125	21	36	45

*** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses. Regressions include country year fixed effects. All data is from Cerra and Saxena (2008). L1 denotes a one-year lag.

Table A2: Civil War Regression Results

VARIABLES	Full Sample (1) growth	Upper middle income (2) growth	Lower middle income (3) growth	Lower income (4) growth
growth (L)	0.226*** (0.0156)	0.259*** (0.0355)	0.290*** (0.0307)	0.141*** (0.0297)
growth (L2)	-0.0251 (0.0158)	-0.0330 (0.0363)	-0.0521* (0.0315)	0.0122 (0.0295)
growth (L3)	0.0332** (0.0156)	0.0639* (0.0358)	-0.0486 (0.0306)	0.0435 (0.0295)
growth (L4)	-0.0530*** (0.0151)	-0.0736** (0.0340)	0.0695** (0.0295)	-0.122*** (0.0303)
civil war	-6.306*** (0.701)	-8.690 (8.352)	-4.863*** (1.115)	-6.999*** (0.974)
civil war (L)	1.517* (0.856)	-1.057 (8.357)	0.316 (1.381)	1.436 (1.190)
civil war (L2)	1.246 (0.856)	-15.83* (8.353)	0.896 (1.368)	2.003* (1.197)
civil war (L3)	-0.184 (0.869)	-0.136 (6.550)	-0.837 (1.380)	0.452 (1.228)
civil war (L4)	1.410* (0.741)	1.074 (5.873)	1.835 (1.129)	1.010 (1.072)
Observations	4529	807	1166	1398
R-squared	0.076	0.080	0.121	0.077
Number of countries	186	34	52	58

*** p<0.01, ** p<0.05, * p<0.1. Standard errors in parentheses. Regressions include country year fixed effects. All data is from Cerra and Saxena (2008). L1 denotes a one-year lag.

Using these estimates we construct impulse response functions for all eight cases. Figures A1 and A2 compare the original impulse response functions presented in CS to our constructed impulse response functions. On the x-axis the graphs display the time after the impulse and on the y-axis the output (level) response in percent. The top rows of figure A1 and A2 display the original graphs from CS while the bottom rows display our reproductions using their data and equation (1). All impulse response functions appear to be identical and so we are confident that we have reproduced the methodology of CS successfully.

B Formal Discussion of the Crisis Coding

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

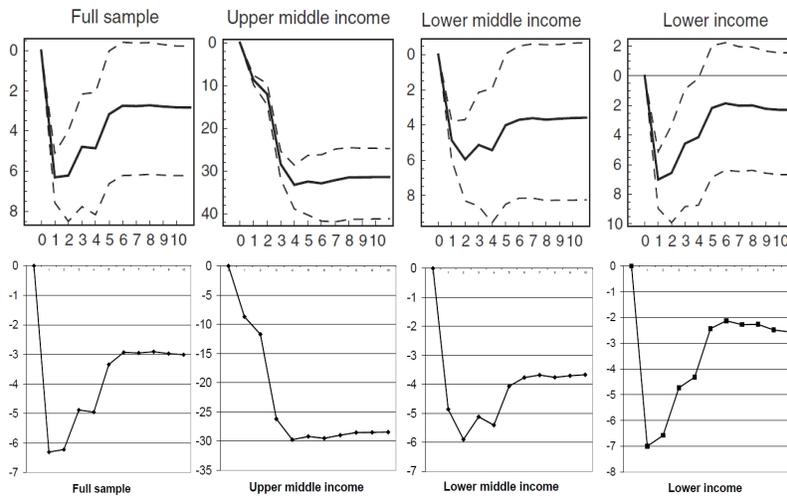


Figure A1: Comparison of impulse response functions to civil war years
 (upper panel Cerra and Saxena (2008), lower panel author's calculations)

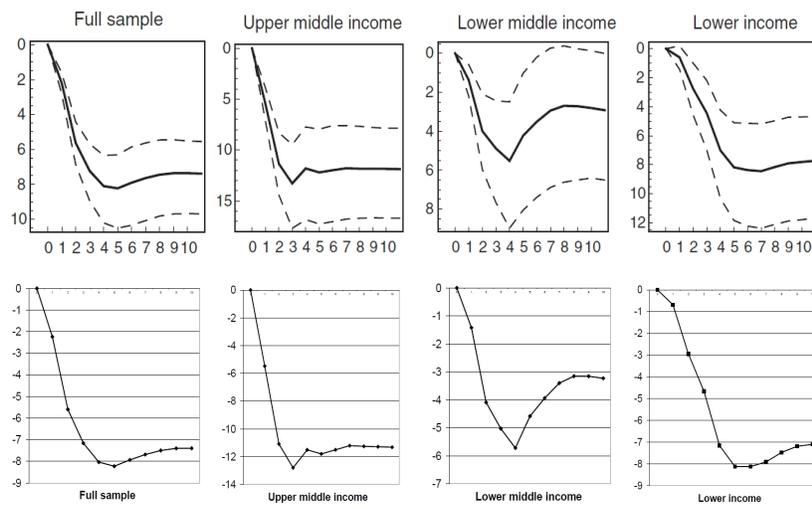


Figure A2: Comparison of impulse response functions to banking crisis starts
 (upper panel Cerra and Saxena (2008), lower panel author's calculations)

(1). Disregarding the *AR* growth process and country fixed effects we can write equation (1)

$$g_t = \sum_{s=0}^4 \delta_s D_{t-s} + \varepsilon_{it}$$

the OLS estimator of the vector of coefficients on the dummy variables, is

$$\hat{\delta} = \left(\frac{D'D}{N} \right)^{-1} \left(\frac{D'g}{N} \right)$$

where N is the number of observations, D is a matrix of the crisis dummy and its lags and g is a vector of growth rates.

If just the *start of crisis* is coded $D_{it} = 1$ then

$$\left(\frac{D'D}{N} \right)^{-1} = \frac{N}{J} I$$

where I is a 5×5 identity matrix and J is the number of conflicts in the sample. Similarly we have

$$\left(\frac{D'g}{N} \right) = \sum_{j=1}^J \begin{pmatrix} x_{j1} \\ x_{j2} \\ x_{j3} \\ x_{j4} \\ x_{j5} \end{pmatrix} N^{-1}.$$

We define

$$\bar{x}_\tau = \frac{1}{J} \sum_{j=1}^J x_{j\tau}$$

the average growth rate in crisis year τ . The OLS estimate of the coefficients δ , $\hat{\delta}$, is then given by

$$\left(\hat{\delta}_0, \hat{\delta}_1, \hat{\delta}_2, \hat{\delta}_3, \hat{\delta}_4 \right) = \left(\frac{D'D}{N} \right)^{-1} \left(\frac{D'g}{N} \right) = (\bar{x}_1, \bar{x}_2, \bar{x}_3, \bar{x}_4, \bar{x}_5). \quad (1)$$

The expression in (1) shows that the OLS estimates $\hat{\delta}$ derived from the crisis start coding simply reflect the average growth rates in the years following crisis start. The coefficient on the third lag, $\hat{\delta}_3$, for example, captures average growth 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 the potential recovery after crisis ends. Assume, for example, that all 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 1b indeed reflect the average growth response to a crisis start.

In order to give an illustration for the OLS estimates if *every year of crisis* is coded as $D = 1$ we need to assume something about the crisis length. Assume

that crisis are three years long so that D is a matrix of 0s and cells of three 1's that move down with each lag. For simplicity, assume that the average growth rate in crisis is constant

$$\bar{x}_1 = \bar{x}_2 = \bar{x}_3 = -s$$

while the growth rate during recovery is another constant

$$\bar{x}_4 = \bar{x}_5 = \bar{x}_6 = \bar{x}_7 = r.$$

The OLS estimate is then

$$\delta = \begin{bmatrix} 3 & 2 & 1 & 0 & 0 \\ 2 & 3 & 2 & 1 & 0 \\ 1 & 2 & 3 & 2 & 1 \\ 0 & 1 & 2 & 3 & 2 \\ 0 & 0 & 1 & 2 & 3 \end{bmatrix}^{-1} \begin{pmatrix} -3s \\ -2s + r \\ -s + 2r \\ 3r \\ 3r \end{pmatrix} = \begin{pmatrix} -\frac{1}{4}r - s \\ \frac{3}{8}r \\ 0 \\ \frac{3}{8}r \\ \frac{3}{4}r \end{pmatrix}$$

which illustrates that the mixing of effects in this way can lead to quite drastic misinterpretations of the timing of both crisis and recovery if the impulse response function is not constructed using three consecutive 1's but only one. The impulse response in the example would show a more pronounced crisis in the first period than the real value followed by immediate recovery in the second year which is still a crisis year.

C Five Years of Civil War

It is straightforward to construct the reaction to five years of civil war from the estimated coefficients under the year coding. Figure A3 shows the resulting output response. As can be seen in the graph the simulated output collapses by more than 20 percent and recovers slightly to a magnitude similar to the one found in figure 1b. This similarity illustrates the fact that the output responses to civil war in CS display the reaction to one single civil war year (with the additional caveats discussed in the comment) not a civil war. Only the simulation of five civil war years will provide an understanding of the true impact of an average civil war.

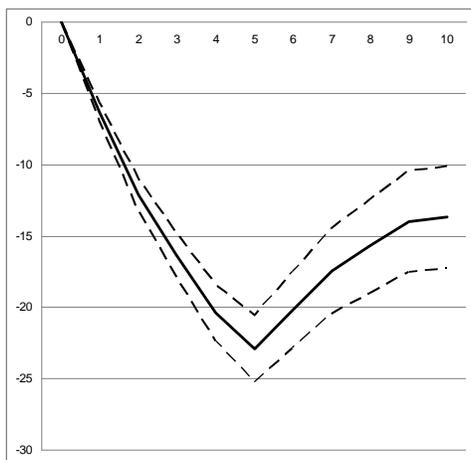


Figure A3: Impulse response to five years of civil war