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Errata:
"Growth in A Time of Debt"

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This note and the accompanying worksheet describe step-by-step the correction of a coding error and other changes to our paper "Growth in a Time of Debt," *American Economic Review Papers and Proceedings*, Vol. 100 No. 2 May, 573-578. The authors wish to thank Thomas Herndon, Michael Ash, and Robert Pollin (HAP) for the careful attention and for pointing out an important correction to our original *Growth in a Time of Debt*.[1]

The authors assert that there are three problems with our post –WWII averages and the paper itself: (i) a coding error that causes the first five countries in the alphabet to be omitted in forming averages for the 1946-2009 period in one figure, (ii) "selective exclusion" of 1946-1950 for New Zealand, and (iii) "unconventional weighting of summary statistics." Their paper is silent on the results of the longer sample dating back to the 1800s for most of the advanced economies and the exercise on emerging markets that are part of our May 2010 paper. It also fails to mention that our median estimates for the postwar sample are very close in magnitude to the averages that they present.

This note is an erratum to our paper Our response in the popular press can be found in the New York Times on April 26, 2013. Also see our supporting technical material on the NYT's webpage. Some, but not all, of the methodology and exclusion issues raised by HAP had already been addressed in a 2012 paper with Vincent Reinhart, "Public Debt Overhangs:

[1] Interested readers are referred to their paper, "Does High Public Debt Consistently Stifle Economic Growth? A Critique of Reinhart and Rogoff," PERI Working Paper Series, Number 322, April 2013, for further details.

Advanced Economies Episodes Since 1800," *Journal of Economic Perspectives* Vol. 26, No. 3, Summer 2012, 69-86. [2] A note entitled "Debt and Growth in Times of War and Peace," which accompanies this correction, also discusses in greater detail the broader question of the unique nature of the years immediately following WWII. This relates to HAP's point about the exclusion of some years from the post–WWII sample. As noted, these authors do not allude to the long-sample results, which is an integral part of our 2010 paper which includes **all** years for which there is data.

The May 2010 Paper

To remain faithful to the analysis in the original paper, in this section ***we use only quotes (in italics)*** from our published papers to put into context the aim of the 2010 paper and describe what was done. In the one instance, we quote from the companion NBER Working Paper 15639 issued in January 2010. But first, we place that paper into context.

The setting

There is a logical sequence to our work.

In May 2008, we published the first of three successive short papers in *American Economic Review Papers and Proceedings.* Reinhart and Rogoff (2008) is about the antecedents of severe financial crises, where we compared the unfolding subprime crisis to the most severe post–WWII financial crises in advanced economies. We concluded:

Perhaps this time will be different as so many argue. Whatever the long-term outcome, the quantitative parallels to earlier post-war industrialized-country financial crises, at least in the pre-crisis period, is worthy of note. Reinhart and Rogoff (2008)

[2] Numerous other papers have contributed to this literature since our original paper in 2010 and have also addressed issues pertaining to the direction of causality between debt and growth, debt thresholds and nonlinearities, as well as examining postwar samples different from ours in the 2010 paper.

The second May (2009) paper was about the aftermath of severe financial crises. We concluded:

An examination of the aftermath of severe financial crises shows deep and lasting effects on asset prices, output and employment.

But we also found that:

The deterioration in government finances is striking, with an average debt rise of over 86 percent… We look at percentage increase in debt, rather than debt-to-GDP, because sometimes steep output drops would complicate interpretation of debt–GDP ratios… the characteristic huge buildups in government debt are driven mainly by sharp falloffs in tax revenue and, in many cases, big surges in government spending to fight the recession. Reinhart and Rogoff (2009)

This brings us to the "Growth in a Time of Debt" May 2010 paper.

The focus of this paper is on the longer term macroeconomic implications of much higher public and external debt.

With the central finding that:

…median growth rates for countries with public debt over roughly 90 percent of GDP are about one percent lower than otherwise. Reinhart and Rogoff (2010)

The empirical approach in the 2010 paper

The annual observations are grouped into four categories, according to the ratio of debt to GDP during that particular year as follows: years when debt to GDP levels were below 30 percent (low debt); years where debt/GDP was 30 to 60 percent (medium debt); 60 to 90 percent (high); and above 90 percent (very high).

In the working paper version we also note:

The four "buckets" encompassing low, medium-low, medium-high, and high debt levels are based on our interpretation of much of the literature and policy discussion on what is considered low, high, etc., debt levels. It parallels the World Bank country groupings according to four income groups. Sensitivity analysis involving a different set of debt cutoffs merits exploration as do country-specific debt thresholds along the broad lines discussed in Reinhart, Rogoff, and Savastano (2003). Reinhart and Rogoff (2010)

In a companion note , Reinhart and Rogoff (August 2010), we observe:

*We do not pretend to argue that growth will be normal at 89 percent and subpar (about one percent lower) at 91 percent debt/GDP any more than a car crash is unlikely at 54mph and near certain at 56mph. However, mapping the theoretical notion of "**vulnerability regions**" to bad* *outcomes by necessity involves defining thresholds, just as traffic signs in the U.S. specify 55mph.*

We now turn to the guide to changes.

Guide to changes

1. **The coding error**

The coding error pointed out to us by HAP excluded from the calculation of the descriptive statistics reported in our paper the following countries in alphabetical order: Australia, Austria, Belgium, Canada, and Denmark. Put differently, the 2010 paper reports the means and medians for Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, the UK and the United States. While the focus of the discussion, in HAP and in the popular press, has been on the debt bucket above 90% for the postwar sample, the coding error is common across the four debt/GDP buckets (0-30, 30-60, 60-90, above 90). It affects both the long sample and the postwar.

Also, in cleaning up the spreadsheets, we took the opportunity to check every cell, and there were a few blank, but non-zero, entries that could throw off formulae. The effects are 0.1-0.2% on some of descriptive statistics reported but nonetheless spelt out for each entry in the top panel of Table 1. The corrected numbers appear in parentheses next to the published numbers. If there is no entry in parentheses, it means the two numbers had no discrepancies.

Returning to the main coding error, Table 1 summarizes for each debt/GDP category the impact of the coding error on the means and medians of both the longer and postwar samples. In line with the impact reported by HAP (page 7), the postwar mean increases by 0.3% for debt-to-GDP above 90%. In the other debt categories, for the long or short samples, the difference between the corrected coding and uncorrected is of a comparable magnitude (if there is any) in either direction. [3] As detailed in Table 1, for some categories there are no changes.

2. Exclusion of GDP growth for Spain 1959-1980

GDP growth for Spain was excluded for the years 1959-1980 (see HAP page 5). At the time the paper was finalized (December, 2009) we had not been able to reconcile different series available for Spanish GDP, so we opted to exclude that period from the analysis. This exclusion primarily affects the below 30% debt/GDP bucket. In all years but 1960 (debt/GDP was 30.1%) Spain's debt was in the lowest 0-30% bucket. GDP growth averaged 6.1% over that time. The inclusion of this data is shown in the third panel of Table 1. Turning to the companion spreadsheet, Spain_old is the original, while Spain_new includes these years. The sheet called Summary_Spain_Full_Sample reflects the corresponding change. The impact on the lowest 0-30% debt bucket is to raise growth by 0.2-0.3% depending on the sample or statistic used. No other point estimates are affected.

3. New Zealand

For New Zealand there are two changes. First, a coding correction that includes 1948, 1949 in the postwar sample as stated in the summary table that accompanied our original spreadsheet sent to HAP. It is important to note that all years for which there is data were already included in the long sample, so this affects only the postwar calculations. Second, the GDP growth series was itself replaced. The original data source for the 2010 paper was Angus Maddison's Database (http://www.ggdc.net/maddison/Maddison.htm), which has been carried over to the Total Economy Database http://www.conference-board.org/data/economydatabase/.

[3] The reader is referred to the worksheets labeled Summary with coding error and Corrected Summary, which provide the descriptive statistics country by country.

The New Zealand Historical Statistics (2003) records a boom of 13.9-15.6% in 1951 followed by a bust in 1952; the Maddison data places this boom-bust in 1950-1951. At any rate, the Official GDP statistics for New Zealand do not start until 1955.

It is not obvious, given available information, which is the correct dating of the boom-bust; there was the historic wool boom (unparalleled to date) but there was also in February 1951 a dock strike that lasted almost half a year and was declared a national emergency.

Consequently, in what follows, we use one of the two series provided by the NZ Historical Statistics (the two estimates stretching back to the 1860s). This is the series we employed in our 2012 *Journal of Economic Perspectives* paper with Vincent Reinhart. We also retain the Maddison series.

We called the sheet with the Maddison data NewZealand_old and the series from the Statistical Office NewZealand_New in the spreadsheet. Summary Final NZ Statistics reports the final corrections using the NZ Historical Statistics series and Summary_Final_Maddison reports the final iteration using the series originally included in our study. Table 1 presents the two scenarios in the bottom two panels.

4. *Assessing the peacetime experience between debt and growth*

Now moving beyond the scope of a replication exercise, we fully agree with much of the HAP commentary on the volatile and irregular experience of growth in the aftermath of World War II (see their discussion of Austria in pages 5 and 6). A major shortcoming of the HAP paper is thatthat it ignores entirely the rapidly expanding post-May 2010 academic literature on debt and growth, which has addressed most of their critiques For example, n our 2012 JEP paper (where we look episode by episode, see Table 2), some of the shorter episodes with war debt are excluded from the analysis altogether (if these episodes last less than five years) or are discussed separately from their peacetime counterparts (as is the case for Australia 1945-1950, Belgium 1920-1926, Canada 1944-1950, and the US 1944-1949). Austria's 1948-1949 boom after massive destruction does not even figure in that analysis. Our main focus in that paper is the longer peacetime spells of high debt. But even in our 2010 paper, we observe:

For example, war debts are arguably less problematic for future growth and inflation than large debts that are accumulated in peacetime. Postwar growth tends to be high as wartime allocation of manpower and resources funnels to the civilian economy. Moreover, high wartime government spending, typically the cause of the debt buildup, comes to a natural close as peace returns. In contrast, a peacetime debt explosion often reflects unstable political economy dynamics that can persist for very long periods. Reinhart and Rogoff (2010)

So where does this leave the postwar peacetime experience? A decade after the war, Austria and other countries in Europe were past the bulk of reconstruction. By late 1952 Japan, Germany, Italy and Austria had also concluded their defaults/debt restructuring (although Greece would remain in default until 1964). The US was well past its somewhat difficult demobilization. Table 2 shows the same exercise for the advanced economies for 1955-2012. Setting the noise aside, growth in the high-debt category is less than half of what it averages for the low-debt category. For the periphery countries of Europe, the difference is even greater. But this discussion does not belong in the errata to Growth in a Time of Debt and the interested reader is referred to Reinhart and Rogoff (2013).

Table 1. Summary of Changes

		30% or less	30-60%	60-90%	above 90%
RR(2010) from paper--see Summary_with_coding_error					
Long Sample					
	Mean	3.7	3.0 (3.1)	3.4 (3.5)	1.7 (1.6)
	Median	3.9	3.1	2.8	1.9
Post war					
	Mean	4.1	2.8	2.8	-0.1(0.0)
	Median	4.2	3.0	2.9	1.6
Coding corrected--see Summary corrected					
Long Sample					
	Mean	3.6	3.1	3.2	1.9
	Median	3.5	3.0	2.8	2.3
Post war					
	Mean	4.0	3.0	2.5	0.3
	Median	3.9	3.0	2.9	1.9
Coding corrected + Spain filled, 1960-1980--see Summary Spain Full Sample					
Long Sample					
	Mean	3.8	3.1	3.2	1.9
	Median	3.8	3.0	2.8	2.3
Post war					
	Mean	4.2	3.0	2.5	0.3
	Median	4.2	3.0	2.9	1.9
Final including New Zealand (NZ Historical Statistics GDP)					
Long Sample					
	Mean	3.8	3.1	3.2	2.0
	Median	3.8	3.0	2.6	2.3
Post war					
	Mean	4.2	3.0	2.4	2.0
	Median	4.2	3.0	2.9	2.5
Final including New Zealand (Maddison GDP)					
Long Sample					
	Mean	3.8	3.1	3.2	1.9
	Median	3.8	3.0	2.8	2.3
Post war					
	Mean	4.2	3.0	2.5	1.0
	Median	4.2	3.0	2.9	1.9

Notes: The country-by-country results as well as the sample coverage is provided in detail in the companion worksheet.

Table 2. Debt and Growth in Times of Peace, 1955-2012

		Average Real GDP growth Debt/GDP				Median Real GDP growth Debt/GDP			
Country	Coverage	30 or less	30 to 60	60 to 90	90 or above	30 or less	30 to 60	60 to 90	90 or above
US	1955-2012	n.a.	3.4	2.7	2.1	n.a.	3.5	3.0	2.2
UK	1955-2012	n.a.	2.6	1.5	2.7	n.a.	2.9	2.1	2.3
Sweden	1955-2012	3.7	2.1	2.9	n.a.	4.0	2.6	2.9	n.a.
Spain	1955-2012	5.6	3.2	2.3	n.a.	5.9	3.3	3.1	n.a.
Portugal	1955-2012	4.9	2.8	0.8	-0.9	5.5	2.7	1.1	-1.6
Norway	1955-2012	4.1	2.7	n.a.	n.a.	4.5	2.9	n.a.	n.a.
New Zealand	1955-2012	2.5	2.8	2.6	n.a.	3.1	2.9	1.9	n.a.
Netherlands	1955-2012	n.a.	3.1	2.9	n.a.	n.a.	3.0	3.0	n.a.
Japan	1956-2012	7.3	4.4	3.7	0.9	8.0	4.2	3.7	1.6
Italy	1955-2012	4.4	4.6	2.3	1.1	3.9	5.4	2.8	1.5
Ireland	1955-2012	5.3	5.8	3.9	2.4	5.4	5.5	4.0	2.1
Iceland	1955-2012	5.5	2.6	-2.7	0.1	6.0	3.5	-2.7	1.6
Greece	1955-2012	5.6	1.4	1.3	1.4	6.2	2.0	0.7	3.2
Germany	1955-2012	4.5	2.0	1.3	n.a.	4.5	1.8	1.3	n.a.
France	1955-2012	4.3	2.2	1.1	0.0	4.9	2.2	1.7	0.0
Finland	1955-2012	3.7	2.3	n.a.	n.a.	3.1	3.3	n.a.	n.a.
Denmark	1955-2012	3.5	0.9	2.4	n.a.	3.1	0.9	2.4	n.a.
Canada	1955-2012	n.a.	4.2	3.0	3.3	n.a.	4.2	2.8	3.5
Belgium	1955-2012	n.a.	4.2	3.2	1.9	n.a.	4.3	3.0	1.8
Austria	1955-2012	4.4	2.4	2.0	n.a.	4.6	2.3	2.4	n.a.
Australia	1955-2012	3.2	4.8	4.4	n.a.	3.1	5.0	4.8	n.a.
Average/median		4.5	3.1	2.2	1.4	4.5	3.0	2.8	1.8
Minimum		2.5	0.9	-2.7	-0.9	3.1	0.9	-2.7	-1.6
Maximum		7.3	5.8	4.4	3.3	8.0	5.5	4.8	3.5

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