

Growth in a Time of Debt (or a Workflow Gone Bad)

POSC 3410 – Quantitative Methods in Political Science

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Goal for Today

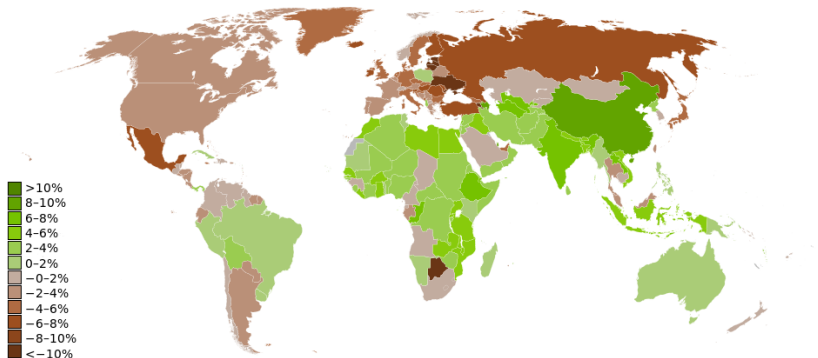
Discuss Reinhart and Rogoff's (2010) analysis of government debt and growth.

Debt and Growth as Current Policy Issue

The financial crisis of 2007-08 was not kind to many countries.

- Overdetermined causes: housing bubble, bank insolvencies, predatory lending, deregulation since 1999, etc.
- The great recession followed in 2009.

The Effect of the Great Recession



The Effect of the Great Recession

USA:

- Unemployment doubled, rising to 10.1% (highest in 30+ years)
- GDP *shrunk* from 2008 to mid-2010.
- Debt rose from 2/3rds GDP to over 100% of GDP.

Greece:

- Unemployment rose from 6% to 21% in three years.
- GDP contracted by over 20%.

Ireland:

- Unemployment rose from 6% to 15% in four years.
- Stock exchange hit a 14-year low.

Dealing with the Great Recession

Countries dealt with recession in the usual way: bailouts and deficit spending.

- Governments accrue debt to prevent further economic losses.

Reinart and Rogoff (RR) (2010) argue this is unwise.

- Debt accumulation like we're seeing now coincides with slowing growth (or, worse, further contraction).

Reinhart and Rogoff's Method

Let's understand RR's research design.

- *Hypothesis*: as debt goes up, GDP growth goes down.

Variables:

- *DV*: GDP growth
- *IV*: public debt/GDP ratio
 - RR treat it as a series of fixed effects/factors.

Findings

RR provide “stylized facts” to illustrate debt/GDP and growth.

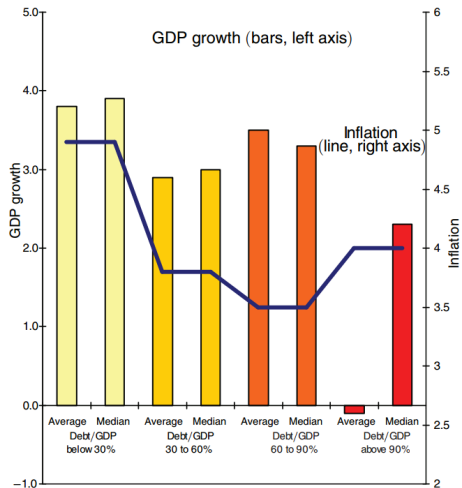


FIGURE 2. GOVERNMENT DEBT, GROWTH, AND INFLATION:
SELECTED ADVANCED ECONOMIES, 1946–2009

Findings

- No relationship between debt/GDP and growth for bottom three debt categories.
- However, >90% and above category shows average GDP loss.
- No relationship between debt/GDP and inflation (the line graph).

Findings

Appendix Table 1. Real GDP Growth as the Level of Debt Varies: Summary
(annual percent change)

Measure	Period	Below 30 percent	30 to 60 percent	60 to 90 percent	90 percent and above
Central (Federal) government debt/ GDP- Advanced economies					
Average	1946-2009	4.1	2.8	2.8	-0.1
Median	1946-2009	4.2	3.0	2.9	1.6

Policy Impact

RR make one of the loudest claims of the negative debt-GDP relationship. Impact includes:

- Numerous well-placed op-eds.
- Testimony before Congress.
- Features on FOX, NPR, MSNBC
- It also became the basis for the Ryan budget and similar austerity measures in Europe.

Policy Impact



Paul Krugman (not pictured): RR may have had more immediate influence than any paper in history of economics.

Policy Impact

Fiscal priorities in the West still reflect RR's findings.

- Follow politics closely and you'll see it.

However, the policy implications follow only if RR's findings are robust.

Replicating Reinhart and Rogoff

Question: did RR actually do their research well? How would we know?

- Fortunately, RR made their data publicly available.

Read in the Data

```
library(RCurl)
library(Zelig)
library(countrycode)
library(ggplot2)
library(mgcv)

data <- getURL("https://raw.githubusercontent.com/svmiller/reinhart-rogooff/master/RR-processes.csv")
Data <- read.csv(text = data)
```

Do Some Recoding/Cleaning

```
Data <- subset(Data, select=c("Country", "Year", "dRGDP", "debtgdp"))  
Data$ccode <- countrycode(Data$Country, "country.name", "cown")
```

```
Data$dgcat <- NA  
Data$dgcat[Data$debtgdp > 0 & Data$debtgdp < 30] <- "0-30%"  
Data$dgcat[Data$debtgdp >= 30 & Data$debtgdp < 60] <- "30-60%"  
Data$dgcat[Data$debtgdp >= 60 & Data$debtgdp < 90] <- "60-90%"  
Data$dgcat[Data$debtgdp >= 90] <- "90% and above"
```

```
Data$dgcat2 <- NA  
Data$dgcat2[Data$debtgdp > 0 & Data$debtgdp < 30] <- "0-30%"  
Data$dgcat2[Data$debtgdp >= 30 & Data$debtgdp < 60] <- "30-60%"  
Data$dgcat2[Data$debtgdp >= 60 & Data$debtgdp < 90] <- "60-90%"  
Data$dgcat2[Data$debtgdp >= 90 & Data$debtgdp < 120] <- "90-120%"  
Data$dgcat2[Data$debtgdp >= 120] <- "Above 120%"
```


Regression Analysis

```
summary(M1 <- lm(dRGDP ~ factor(dgcat), data=Data))
```

```
##
## Call:
## lm(formula = dRGDP ~ factor(dgcat), data = Data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -13.1101  -1.5915  -0.0385   1.5203   24.2129
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)      4.1735     0.1414  29.523 < 2e-16 ***
## factor(dgcat)30-60% -1.0572     0.1988  -5.319 1.25e-07 ***
## factor(dgcat)60-90% -0.9517     0.2505  -3.799 0.000153 ***
## factor(dgcat)90% and above -2.0055     0.3120  -6.427 1.89e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.918 on 1167 degrees of freedom
## Multiple R-squared:  0.04446,    Adjusted R-squared:  0.042
## F-statistic: 18.1 on 3 and 1167 DF,  p-value: 1.75e-11
```

Regression Analysis

```
summary(M2 <- lm(dRGDP ~ factor(dgcat2), data=Data))
```

```
##
## Call:
## lm(formula = dRGDP ~ factor(dgcat2), data = Data)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -12.5037  -1.5688  -0.0462   1.5320  24.2129
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)      4.1735     0.1413  29.534 < 2e-16 ***
## factor(dgcat2)30-60% -1.0572     0.1987  -5.321 1.24e-07 ***
## factor(dgcat2)60-90% -0.9517     0.2504  -3.800 0.000152 ***
## factor(dgcat2)90-120% -1.7676     0.3573  -4.947 8.63e-07 ***
## factor(dgcat2)Above 120% -2.6120     0.5426  -4.814 1.67e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 2.917 on 1166 degrees of freedom
## Multiple R-squared:  0.04599,    Adjusted R-squared:  0.04271
## F-statistic: 14.05 on 4 and 1166 DF,  p-value: 3.348e-11
```

Be Mindful What Your Regression is Saying

Did anyone see something amiss?

- Let's use Zelig to show the problem here.

```
Data$dgcat <- as.factor(Data$dgcat)
summary(Z1 <- zelig(dRGDP ~ dgcat, data = Data, model="ls"))

Z1.low <- setx(Z1, dgcat = "90% and above")
summary(Z1.sim <- sim(Z1, x = Z1.low))
```

Expected Values of GDP Growth for >90% Debt

```
## $`Expected Values: E(Y|X)`  
##      mean      sd      50%      2.5%      97.5%  
## 1 2.175847 0.2786447 2.17351 1.629431 2.71439
```

See the problem now?

RR's Summary Statistics

##	RR.correct.mean	dgcats
## 0-30%	4.173520	0-30%
## 30-60%	3.116318	30-60%
## 60-90%	3.221804	60-90%
## 90% and above	2.167972	90% and above

The expected value of Y we got makes sense with the intercept (and these means), but it's not what RR reported.

- So what happened?

Why Can't We Replicate RR?

Why can't we replicate RR's Figure 2 (and Table 1 from the Appendix)?

1. RR make curious case exclusions of Australia, Canada, and New Zealand shortly after WWII.
 - Argument: they're unique because it's WWII (a sui generis event).
 - However: they include the U.S. during that time.
2. RR also had a silly spreadsheet error that came from doing their work in Excel.
 - This omits Australia, Austria, Belgium, Canada, and Denmark from their analysis.
3. RR weight means equally by country rather than country year.
 - i.e. the U.S. has four years in the highest debt category (growth: -2%)
 - the UK has 19 years in the highest debt category (growth: 2.4%)
 - However, the four U.S. observations are weighted equally with the U.K.'s 19 years.

Correct Means per Debt Category

##	RR.correct.mean	dgcats
## 0-30%	4.173520	0-30%
## 30-60%	3.116318	30-60%
## 60-90%	3.221804	60-90%
## 90% and above	2.167972	90% and above

What RR Reported

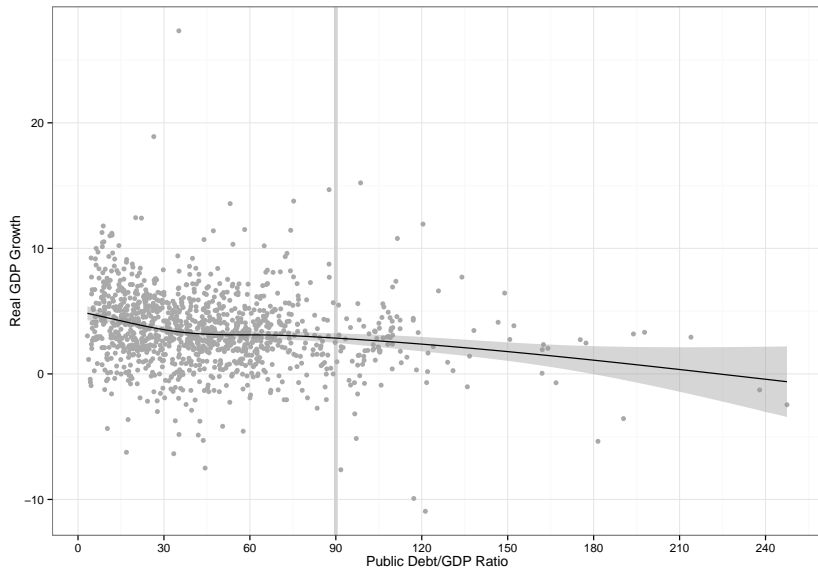
##	RR.published.mean	dgcats
## 0-30%	4.08921971	0-30%
## 30-60%	2.86594921	30-60%
## 60-90%	3.39943999	60-90%
## 90% and above	-0.06206224	90% and above

Look Familiar?

Appendix Table 1. Real GDP Growth as the Level of Debt Varies: Summary
(annual percent change)

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Another Look at the Debt/GDP Relationship



Conclusion

RR still influence policy debates on debt and economic growth.

- However, their findings suffer from *major* inferential and workflow failures.

Don't make their mistakes when you do this yourself.

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