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

POSC 3410 – Quantitative Methods in Political Science

Steven V. Miller

Department of Political Science

CLEMSON UNIVERSITY

Goal for Today

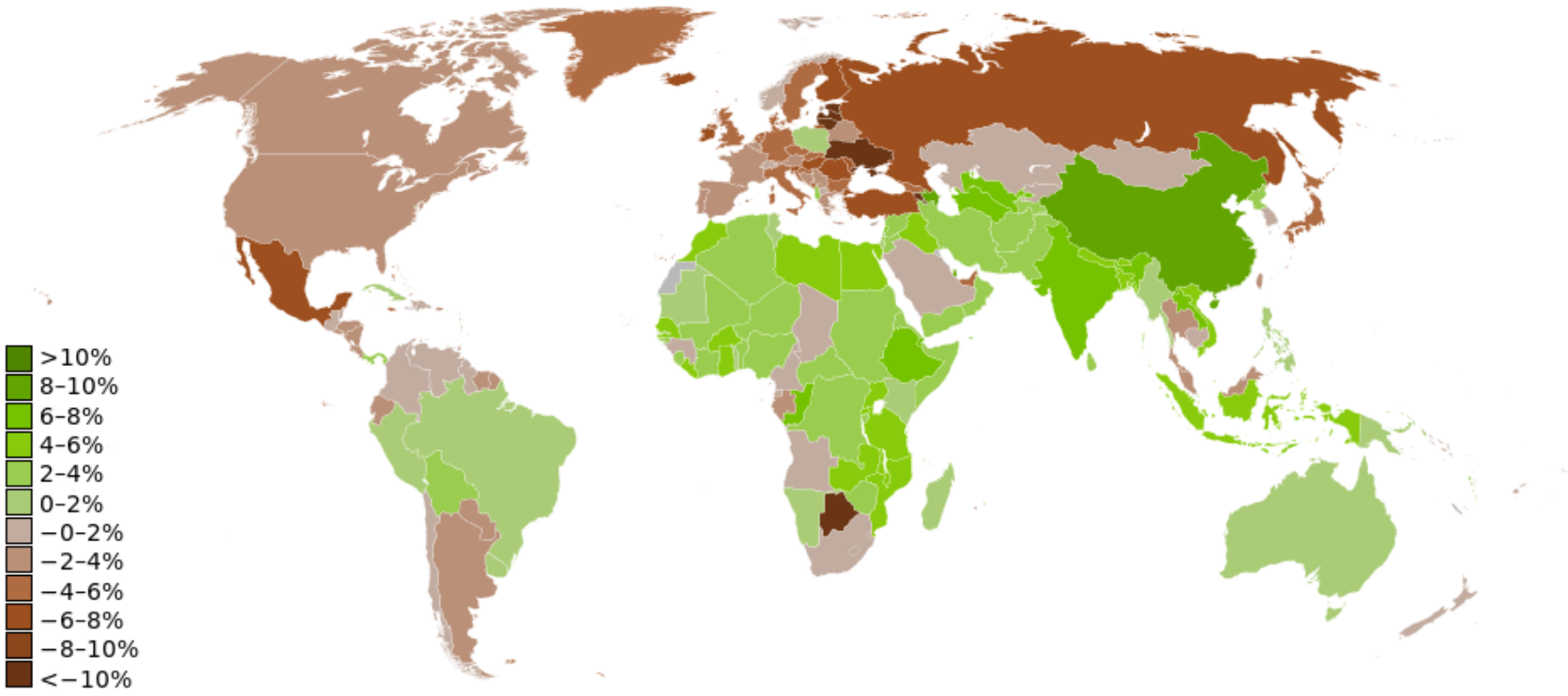
Discuss Reinhart and Rogoff's (2010) analysis of government debt and growth.

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.

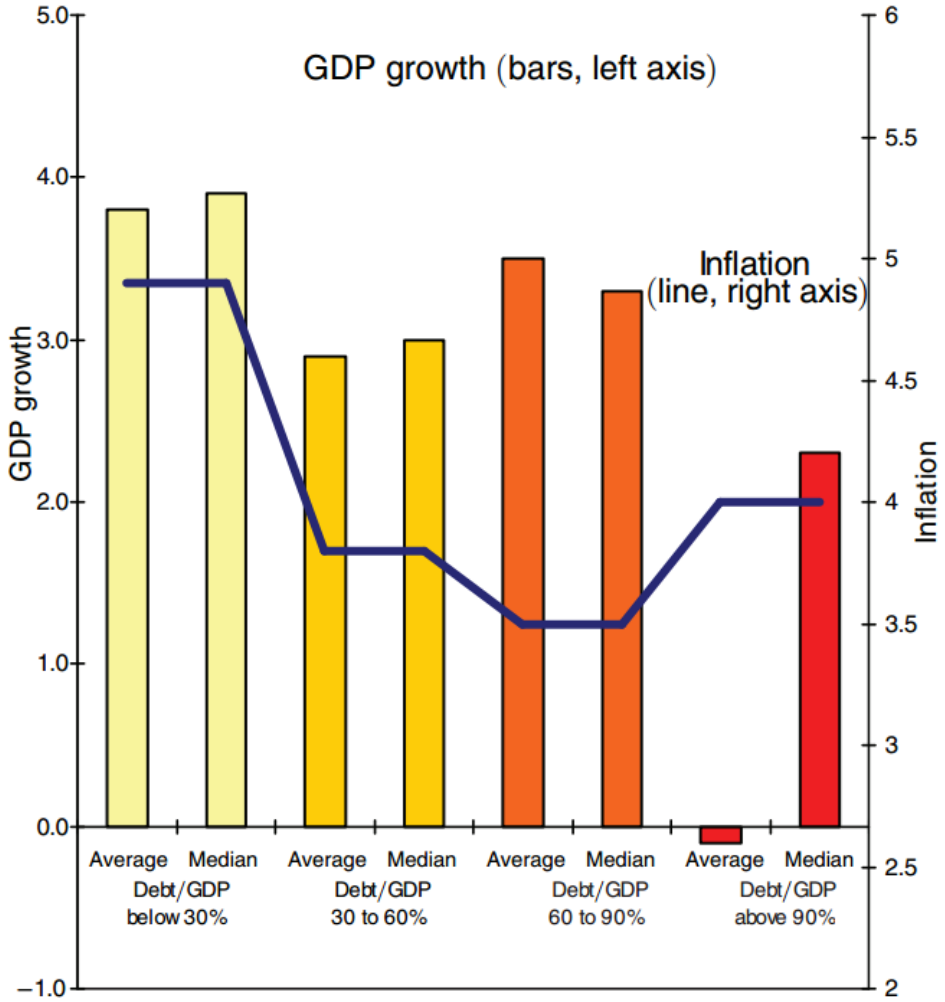


FIGURE 2. GOVERNMENT DEBT, GROWTH, AND INFLATION: SELECTED ADVANCED ECONOMIES, 1946–2009

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-rogoff/master/RR-proces
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 You're 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 2.16839 0.2790141 2.171062 1.65004 2.712203
```

See the problem now?

RR's Summary Statistics

```
##                   RR.correct.mean          dgcat
## 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          dgcat
## 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

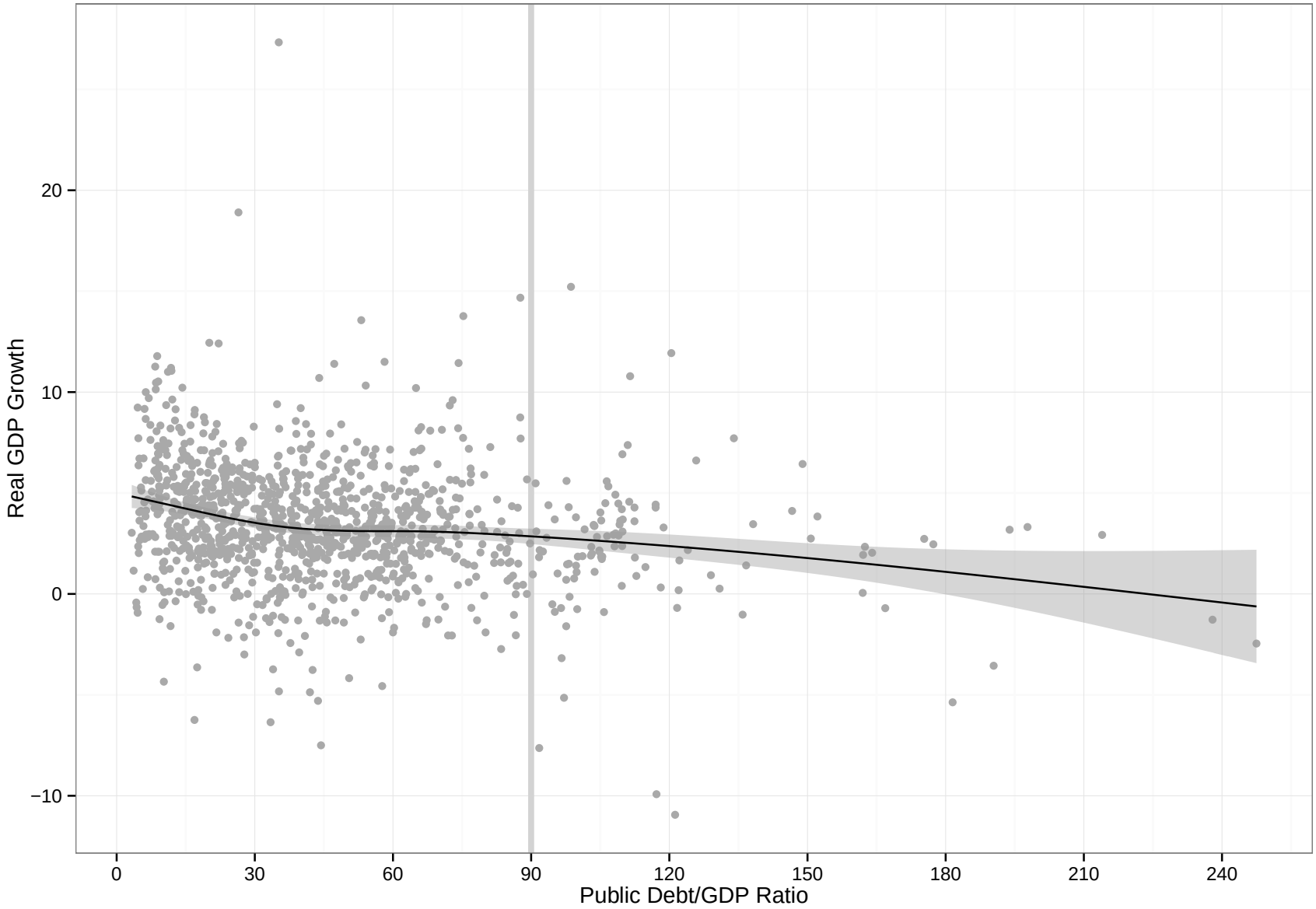
```
##                 RR.published.mean          dgcat
## 0-30%                  4.08921971          0-30%
## 30-60%                 2.86594921         30-60%
## 60-90%                 3.39943999         60-90%
## 90% and above         -0.06206224 90% and above
```

Look Familiar?

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

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

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.

Table of Contents