

Convergence

16MA4b

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Summary

According to the Solow model, poor countries grow more rapidly if they have the same production function and parameters as rich countries. As a quick exercise we reproduce Figures 3.5 and 3.6 in Jones and Vollrath (2013), a figure similar to Figure 1.7 in Romer (2012).

Code

```
library(dplyr)
```

```
##  
## Attaching package: 'dplyr'  
## The following objects are masked from 'package:stats':  
##  
##   filter, lag  
## The following objects are masked from 'package:base':  
##  
##   intersect, setdiff, setequal, union
```

```
library(tidyr)  
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 3.3.2
```

```
library(readstata13)
```

Import Penn World Table dataset (See Feenstra, Inklaar, and Timmer (2015)):

```
pwt = read.dta13("../pwt90.dta")
```

The following vector contains the list of the OECD countries.

```
oecd = c("Switzerland",  
         "Australia",  
         "Austria",  
         "Belgium",  
         "Canada",  
         "Chile",  
         "Czech Republic",  
         "Denmark",  
         "Estonia",  
         "Finland",  
         "France",  
         "Germany",  
         "Greece",  
         "Hungary",
```

```

"Iceland",
"Ireland",
"Israel",
"Italy",
"Japan",
"Republic of Korea",
"Latvia",
"Luxembourg",
"Mexico",
"Netherlands",
"New Zealand",
"Norway",
"Poland",
"Portugal",
"Slovakia",
"Slovenia",
"Spain",
"Sweden",
"Switzerland",
"Turkey",
"United Kingdom",
"United States")

```

Select important columns and reshape, calculate GDP per Worker. Add information about OECD membership.

```

df.world <- pwt %>%
  select(country, countrycode, year, rgdpo, emp) %>%
  filter(year==1960 | year==2010) %>%
  mutate(gdp_per_worker = rgdpo / emp) %>%
  select(-rgdpo, -emp) %>%
  spread(year, gdp_per_worker) %>%
  mutate(avg.growth = (`2010` / `1960`)^(1/(2010-1960)) - 1,
         oecd = (country %in% oecd))

```

```
head(df.world)
```

##	country	countrycode	1960	2010	avg.growth	oecd
## 1	Albania	ALB	NA	30432.51	NA	FALSE
## 2	Algeria	DZA	55357.004	46326.00	-0.00355566	FALSE
## 3	Angola	AGO	NA	19789.84	NA	FALSE
## 4	Anguilla	AIA	NA	NA	NA	FALSE
## 5	Antigua and Barbuda	ATG	NA	NA	NA	FALSE
## 6	Argentina	ARG	8541.982	43094.98	0.03289782	FALSE

OECD Countries

```

df.oecd = df.world %>% filter(oecd==TRUE)
mod.oecd = lm(avg.growth ~ `1960`, data = df.oecd)

```

```
summary(mod.oecd)
```

```

##
## Call:
## lm(formula = avg.growth ~ `1960`, data = df.oecd)

```

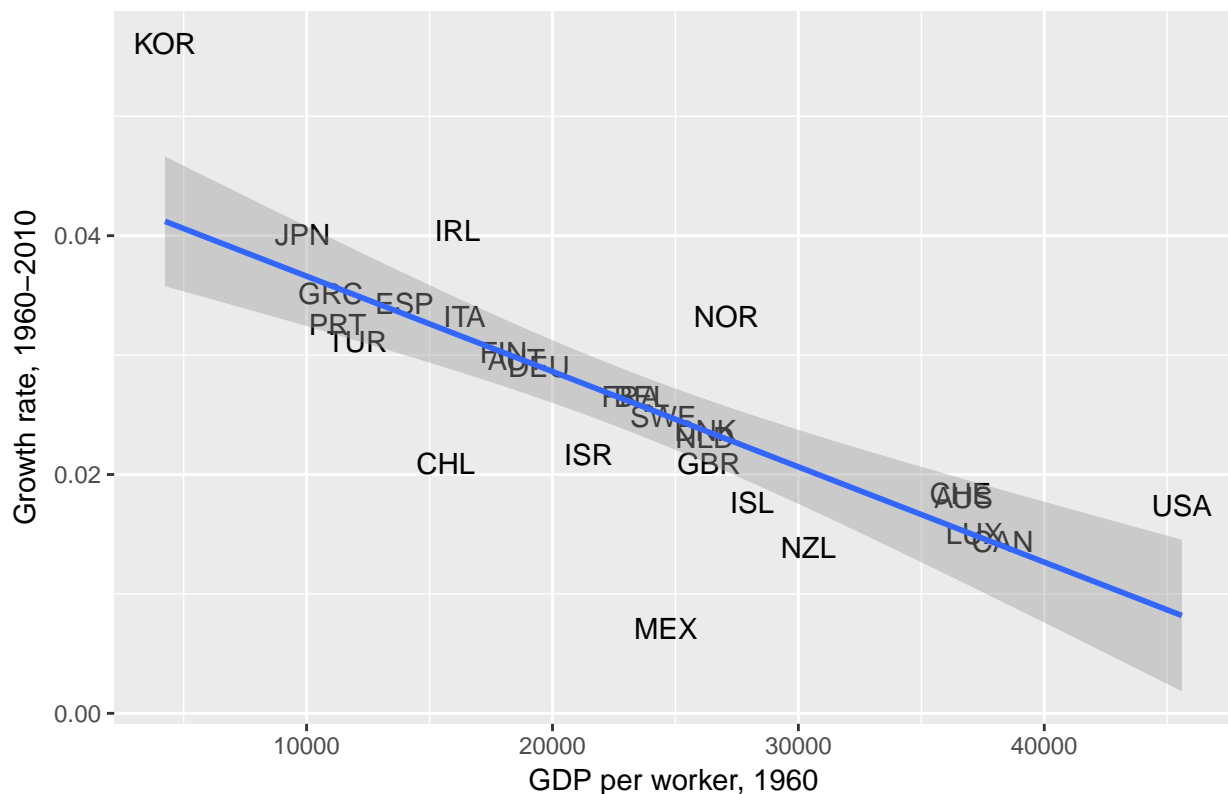
```
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.0178259 -0.0027419  0.0000152  0.0020114  0.0148874
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  4.459e-02  3.128e-03  14.257 8.41e-14 ***
## `1960`      -7.983e-07  1.254e-07  -6.367 9.62e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.006473 on 26 degrees of freedom
## (7 observations deleted due to missingness)
## Multiple R-squared:  0.6092, Adjusted R-squared:  0.5942
## F-statistic: 40.54 on 1 and 26 DF,  p-value: 9.619e-07
```

```
df.world %>%
  filter(oecd==TRUE) %>%
  ggplot(aes(x=`1960`, y=avg.growth)) +
  geom_text(aes(label=countrycode)) +
  geom_smooth(method='lm') +
  labs(x="GDP per worker, 1960", y="Growth rate, 1960-2010",
       title="Convergence in the OECD, 1960-2010")
```

```
## Warning: Removed 7 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 7 rows containing missing values (geom_text).
```

Convergence in the OECD, 1960–2010



Entire world

```
mod.world = lm(avg.growth ~ `1960`, data = df.world)
```

```
summary(mod.world)
```

```
##
## Call:
## lm(formula = avg.growth ~ `1960`, data = df.world)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.050861 -0.009297 -0.000494  0.009469  0.037462
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  2.455e-02  2.696e-03   9.106 5.43e-14 ***
## `1960`      -2.173e-07  1.505e-07  -1.444   0.153
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.01548 on 80 degrees of freedom
## (100 observations deleted due to missingness)
## Multiple R-squared:  0.0254, Adjusted R-squared:  0.01321
## F-statistic: 2.085 on 1 and 80 DF, p-value: 0.1527
```

The negative slope is no longer statistically significant.

```
df.world %>%
  ggplot(aes(x=`1960`, y=avg.growth)) +
  geom_text(aes(label=countrycode)) +
  geom_smooth(method="lm") +
  labs(x="GDP per worker, 1960", y="Growth rate, 1960-2010",
       title="Lack of convergence for the world, 1960-2010")
```

```
## Warning: Removed 100 rows containing non-finite values (stat_smooth).
```

```
## Warning: Removed 100 rows containing missing values (geom_text).
```

