Durf

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```
set.seed(25)
data[sample(nrow(data), 10, replace=FALSE), ]
```

```
##                      Urbanization     GDP Labor    Finance Birth_rate College
##   -2016            0.6110309 11895.0 424.9 0.07268600       6.12   19.78
##   -2014              0.4227578  6518.4 264.7 0.06891262      12.21   12.93
##   -2010              0.3380282  4519.0 224.3 0.05713654      13.96    9.93
##   -2002                     NA  4151.5    NA         NA      11.56   15.69
##    -2006        0.4865424  4161.8    NA 0.02724782       9.87    7.98
##   -2008              0.8492380 11813.1 570.3 0.13954800       8.17   15.61
##   -2007              0.4003623   720.1    NA 0.03763366      14.93    1.11
##     -2008    0.3965275  4142.5 248.2 0.04482800      14.31    6.53
##    -2016        0.6338259 13789.3 293.2 0.05294685       9.03   12.19
##    -2019      0.5297069 21237.1 404.1 0.06919495      13.31   35.98
##                      College_ratio
##   -2016          0.046552....
##   -2014            0.048847....
##   -2010            0.044271....
##   -2002                      NA
##    -2006                NA
##   -2008            0.027371....
##   -2007                      NA
##     -2008  0.026309....
##    -2016      0.041575....
##    -2019    0.089037....
```

Straight-up pooled regression

```
m1 <- lm(log(GDP) ~ Urbanization + log(Labor) + Finance + Birth_rate + College_ratio,
         data = data)
coeftest(m1, df = Inf, vcov = vcovHC(m1, type = "HC1"))
```

```
##
## z test of coefficients:
##
##                Estimate Std. Error z value  Pr(>|z|)
## (Intercept)   1.0131777  0.1586472  6.3864 1.699e-10 ***
## Urbanization  1.2064188  0.1709118  7.0587 1.680e-12 ***
## log(Labor)    1.0945919  0.0152898 71.5899 < 2.2e-16 ***
## Finance       2.8583162  0.6742181  4.2395 2.241e-05 ***
## Birth_rate    0.0583962  0.0048592 12.0176 < 2.2e-16 ***
## College_ratio 9.4148418  0.9473645  9.9379 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Region fixed effects regression

```
m2 <- plm(log(GDP) ~ Urbanization + log(Labor) + Finance + Birth_rate + College_ratio,
          data = data, model = "within")
coeftest(m2, df = Inf, vcov = vcovHC(m2, type = "HC1"))
```

```
##
## z test of coefficients:
##
##                Estimate Std. Error z value  Pr(>|z|)
## Urbanization  4.3924284  0.5463130  8.0401 8.974e-16 ***
## log(Labor)    0.8657813  0.1366146  6.3374 2.337e-10 ***
## Finance       3.0840124  1.5428487  1.9989 0.0456183 *
## Birth_rate    0.0050896  0.0104284  0.4880 0.6255156
## College_ratio 6.1050108  1.8010435  3.3897 0.0006997 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Region fixed effects but estimate in first differences regression

```
m3 <- plm(log(GDP) ~ Urbanization + log(Labor) + Finance + Birth_rate + College_ratio,
          data = data, model = "fd")
coeftest(m3, df = Inf, vcov = vcovHC(m3, type = "HC1"))
```

```
##
## z test of coefficients:
##
##                  Estimate  Std. Error z value  Pr(>|z|)
## (Intercept)    0.08797485  0.00623837 14.1022 < 2.2e-16 ***
## Urbanization   1.40137073  0.31491194  4.4500 8.585e-06 ***
## log(Labor)     0.20719298  0.07261328  2.8534  0.004326 **
## Finance       -2.34247232  0.81831642 -2.8626  0.004202 **
## Birth_rate    -0.00083921  0.00238197 -0.3523  0.724598
## College_ratio -0.62878896  0.61235363 -1.0268  0.304496
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Region and time fixed effects regression

```
m4 <- plm(log(GDP) ~ Urbanization + log(Labor) + Finance + Birth_rate + College_ratio,
          data = data, model = "within", effect = "twoways")
coeftest(m4, df = Inf, vcov = vcovHC(m4, type = "HC1"))
```

```
##
## z test of coefficients:
##
##                 Estimate Std. Error z value  Pr(>|z|)
## Urbanization   1.2277355  0.4484721  2.7376 0.0061890 **
## log(Labor)     0.5289553  0.1450987  3.6455 0.0002669 ***
## Finance       -1.5154153  0.8119288 -1.8664 0.0619800 .
## Birth_rate     0.0090604  0.0100527  0.9013 0.3674355
## College_ratio  3.2401107  1.6932715  1.9135 0.0556814 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Only time fixed effects regression

```
m5 <- plm(log(GDP) ~ Urbanization + log(Labor) + Finance + Birth_rate + College_ratio,
          data = data, model = "within", effect = "time")
coeftest(m5, df = Inf, vcov = vcovHC(m5, type = "HC1"))
```

```
##
## z test of coefficients:
##
##               Estimate Std. Error z value  Pr(>|z|)
## Urbanization  0.832742   0.370352  2.2485 0.0245433 *
## log(Labor)    1.081261   0.031863 33.9347 < 2.2e-16 ***
## Finance       0.335597   2.151472  0.1560 0.8760451
## Birth_rate    0.036157   0.010811  3.3443 0.0008249 ***
## College_ratio 5.384494   1.940591  2.7747 0.0055258 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```