World development indicators

Which country will develop more

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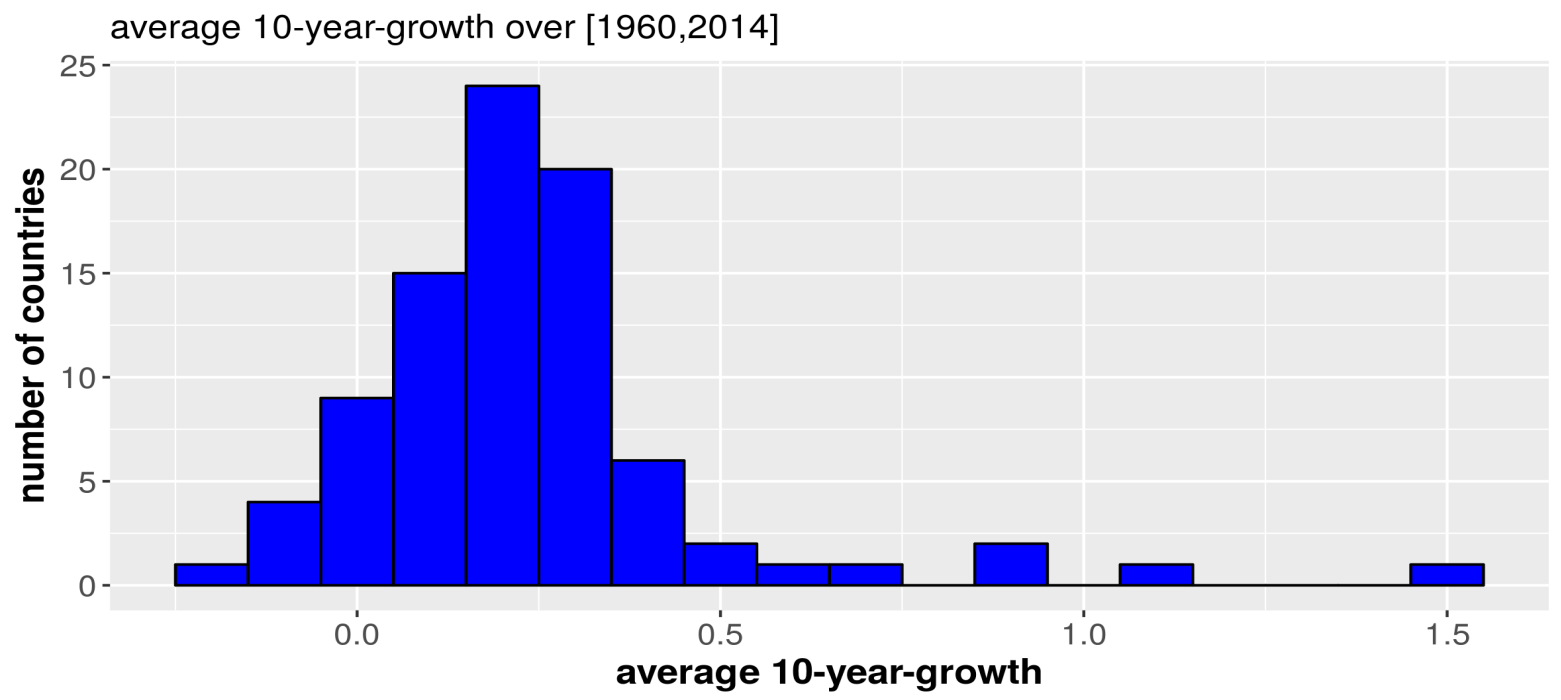
Bibliography

We took inpsiration from:
mettere libro

10-year-Growth definition and average



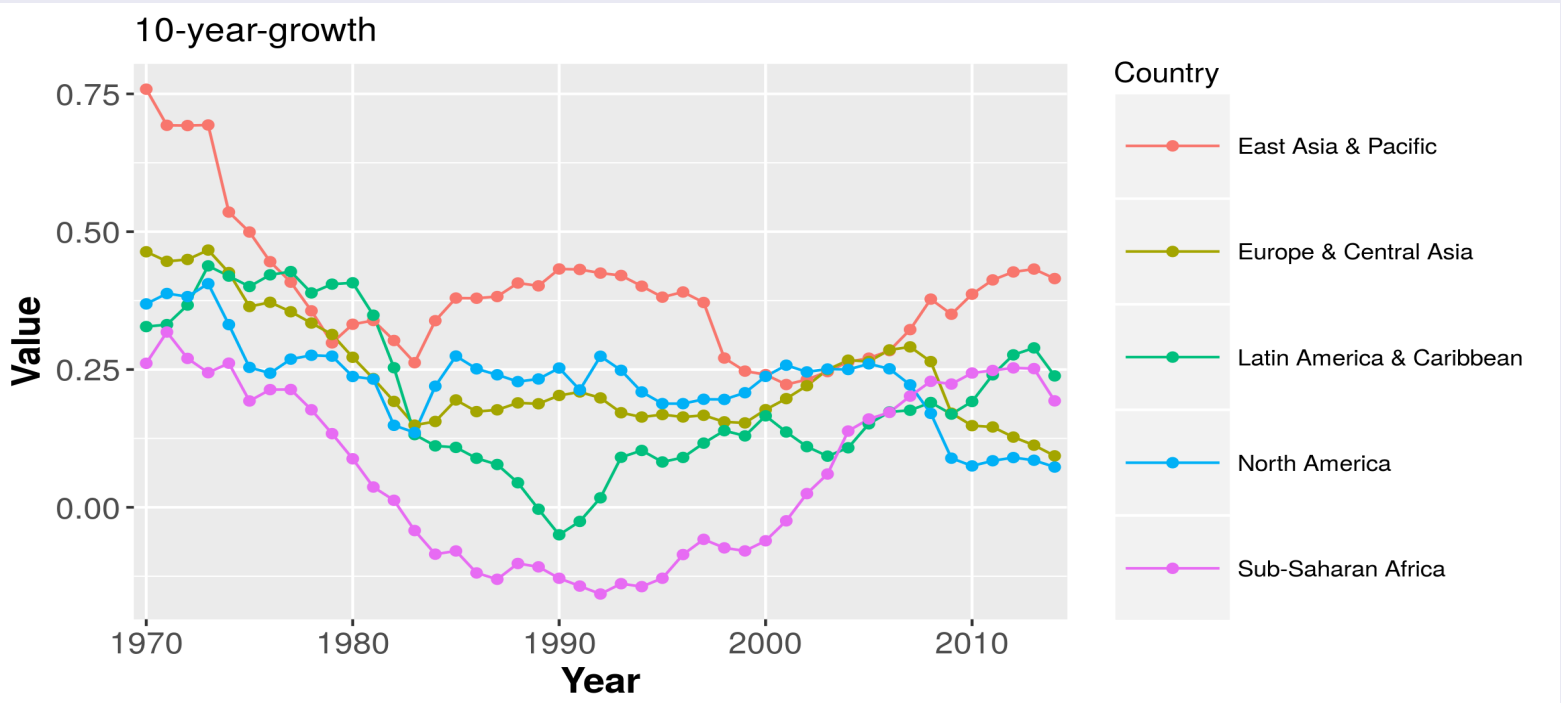
Definition

The 10-year-Growth is the 10-year percentage variation of the GDP per capita in constant 2005 US$. More formally,

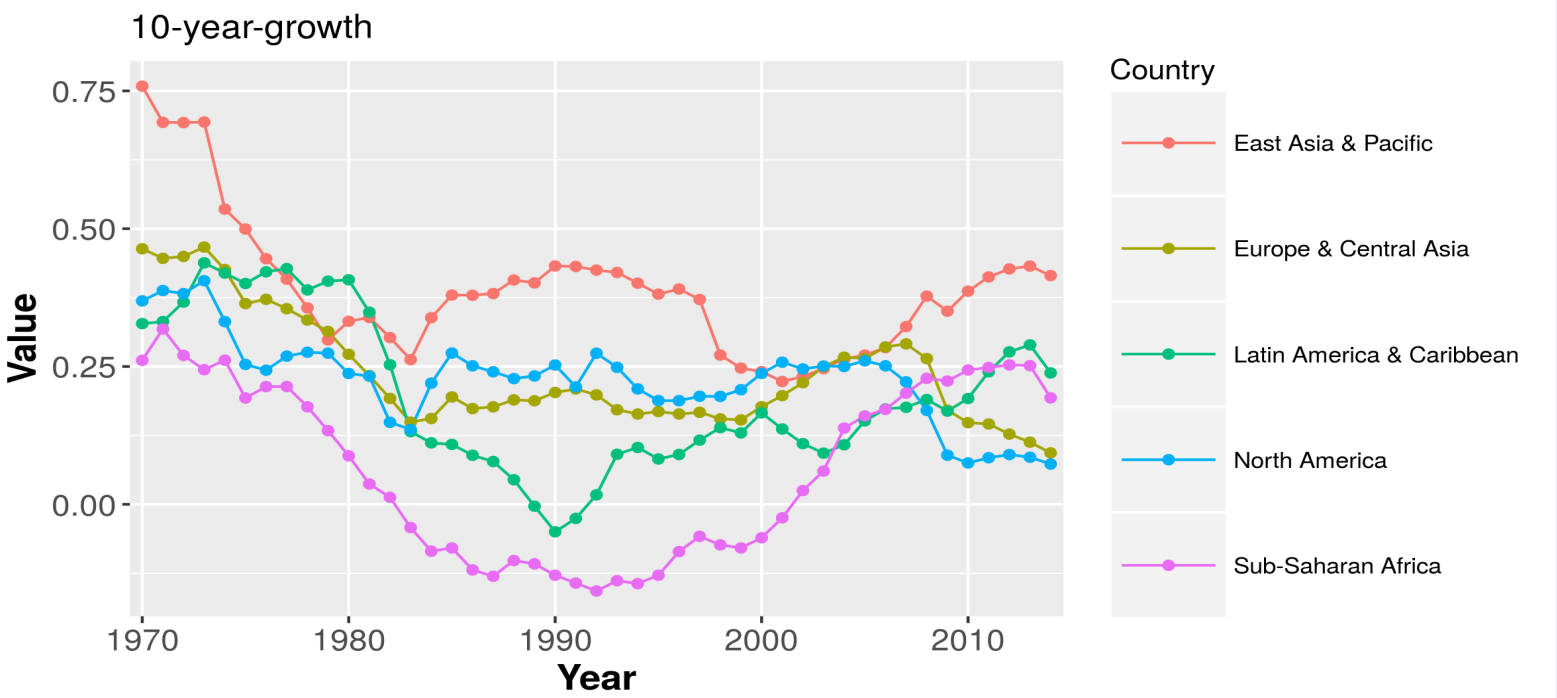
$$Growth_t := \frac{GDP_t - GDP_{t-10}}{GDP_{t-10}} \tag{1}$$

where GDP is the Gross Domestic Product per capita

10-year-growth by region



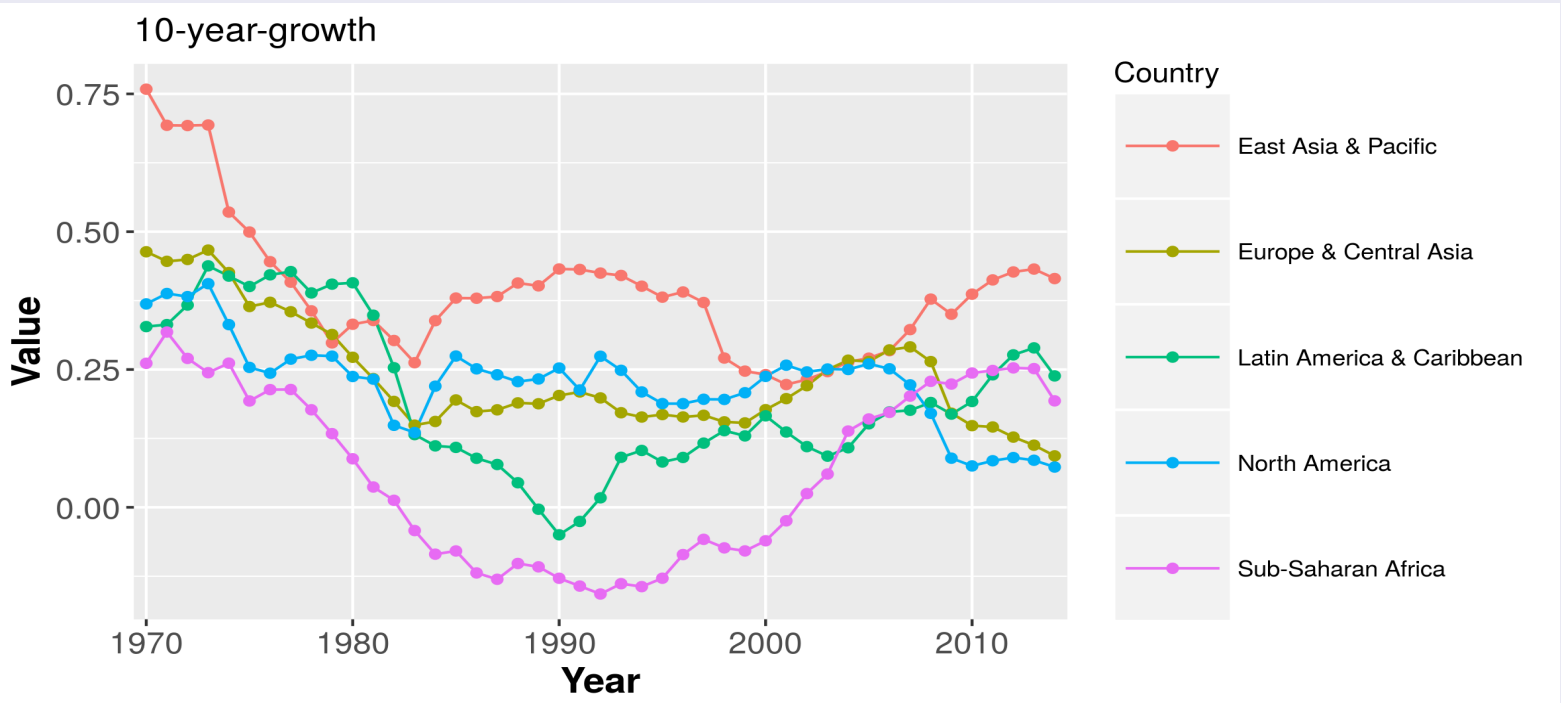
10-year-growth by region



Remark 1

significant differences between decades $\Longrightarrow$ dummy for decades

10-year-growth by region



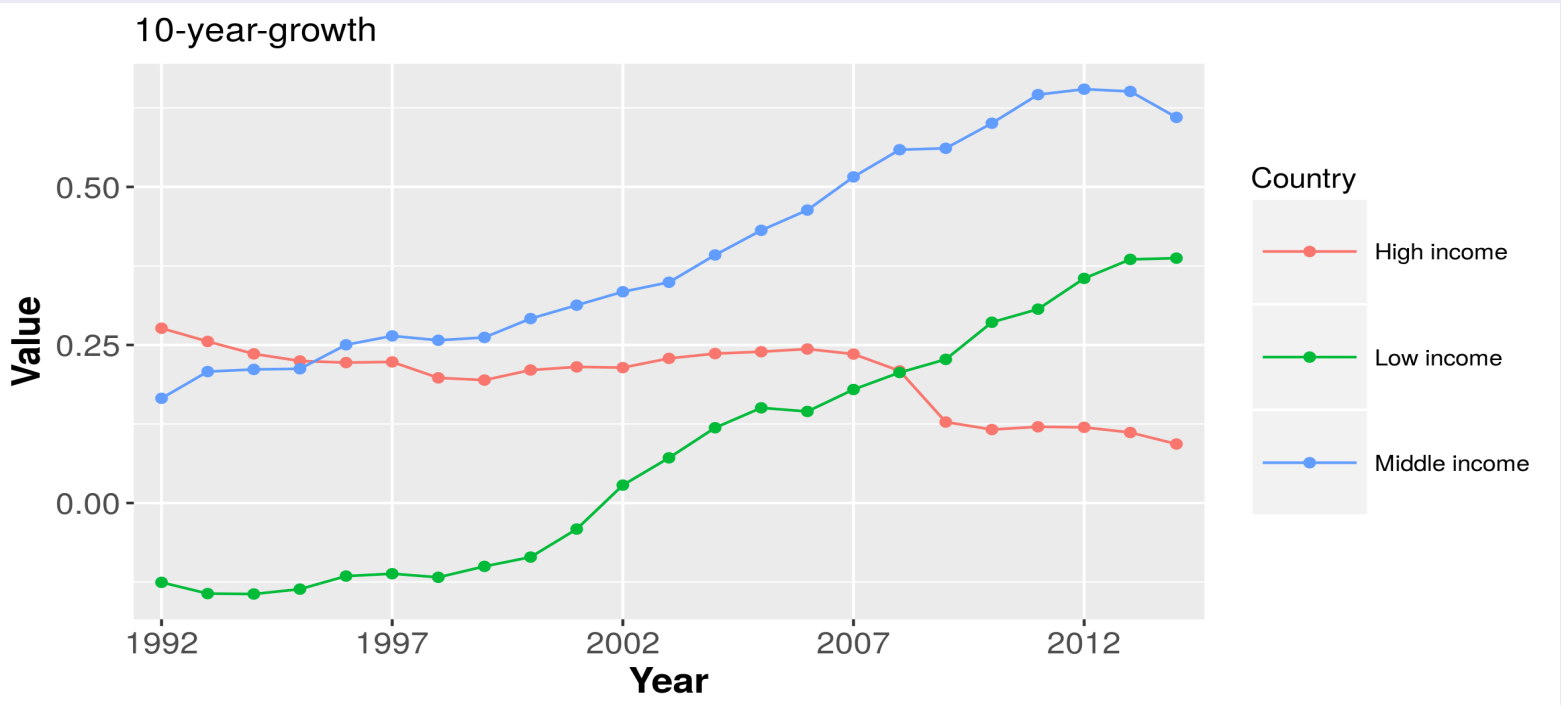
Remark 1

significant differences between decades $\Longrightarrow$ dummy for decades

Remark 2

different growth patterns for different regions $\Longrightarrow$ dummy for Asia and dummy for Africa

10-year-growth by Income group



Remark 3

different growth patterns for different Income groups $\Longrightarrow$ dummy for High Income and dummy for Low Income

The Regressors: State and Environmental variables

State variables: $\underline{h}_t$

- Education $:= \frac{\text{tot enrolment primary school}}{\text{population}}$ [%]
- Health $:= \frac{1}{\text{life expectancy at birth}}$ $[\text{year}]^{-1}$
- Fertility := average number of births per woman

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Envirnonmental variables: $\underline{y}_t$

- Inflation [%]
- GDP := log(GDP)
- FDI := financial capital owned by foreign investors [% of GDP]
- Openess := $\frac{\text{Inport}+\text{Export}}{\text{GDP}}$
- Consumption := households consumption expenditure [% of GDP]
- Investment := government expenditures for goods and services [% of GDP]

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abstract model

$$\Longrightarrow \; Growth_t = F(\underline{h}_{t-10}, \underline{y}_{t-10})$$

Linear model

Let $\epsilon \sim N(0, \sigma^2)$

complete model

$$Growth_{glm} = \beta_{0glm} + \beta_{1glm}\text{fertility} + \beta_2\text{FDI} + \beta_{3glm}\text{GDP} + \beta_4\text{education} + \beta_5\text{consumption} + \beta_6\text{inflation} + \beta_7\text{health} + \beta_{8glm}\text{investment} + \beta_9\text{openess} + \epsilon$$

[1]

$$g \in \{[1983, 1993], [1993, 2003], [2003, 2013]\}$$

$$l \in \{\text{Asia}, \text{Africa}, \text{Others}\}$$

$$m \in \{\text{High Income}, \text{Medium Income}, \text{Low Income}\}$$

[1] After stepwise regression *openess* and some interaction terms are dropped

lm output

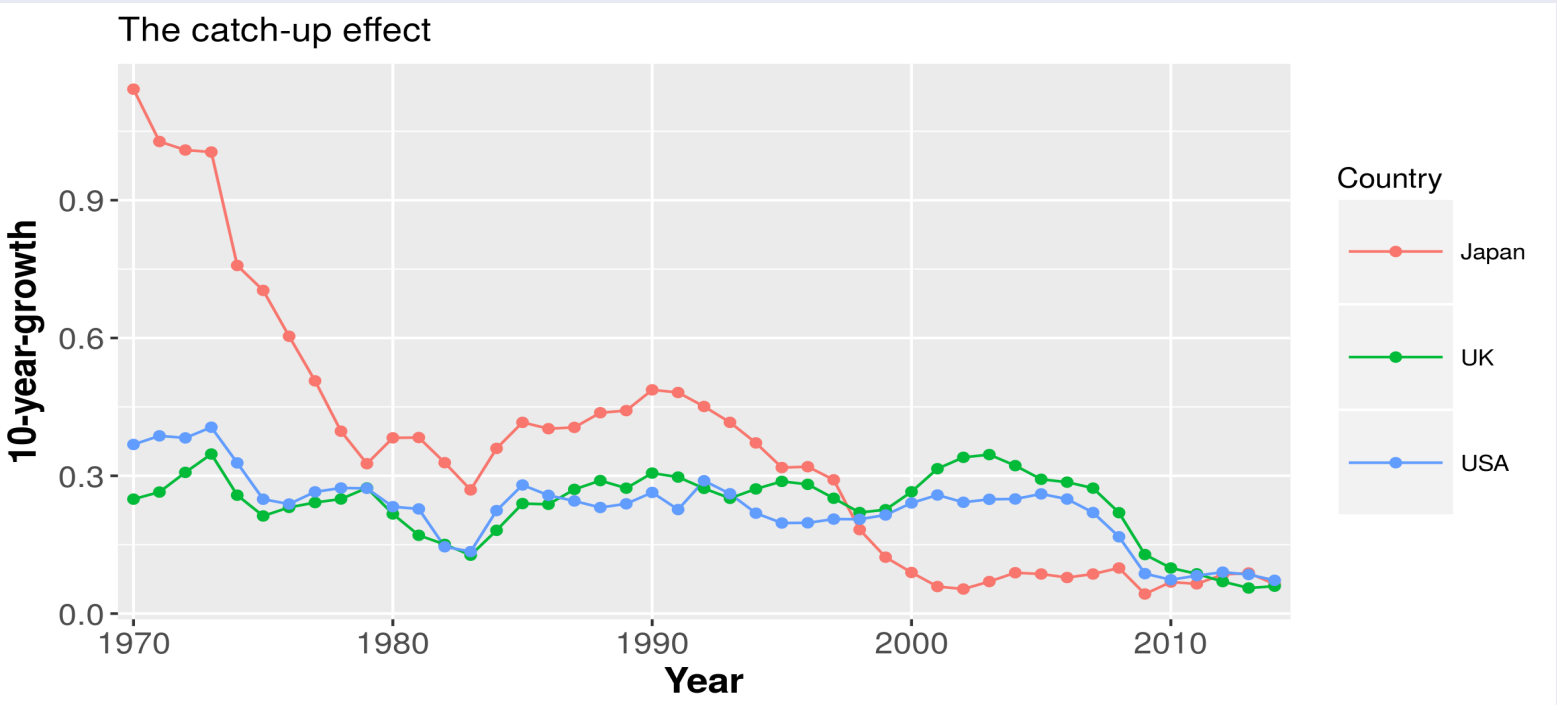
	Model 1		
(Intercept)	0.9531 (0.3791)*	fertility:I1	0.0804 (0.0297)**
fertility	−0.0849 (0.0244)***	investment:I1	−0.0354 (0.0073)***
FDI	−0.0085 (0.0063)	investment:I2	0.0327 (0.0088)***
GDP	−0.0903 (0.0305)**	GDP:R1	−0.3070 (0.0348)***
education	−0.0025 (0.0010)*	fertility:R1	−0.3880 (0.0362)***
consumption	0.0047 (0.0010)***	fertility:R2	−0.0527 (0.0274)
health	−21.0428 (11.8102)	investment:R2	−0.0425 (0.0073)***
R1	3.8459 (0.3718)***	R^2	0.8705
R2	0.8626 (0.1585)***	Adj. R^2	0.8364
I1	1.0546 (0.4503)*	Num. obs.	116
I2	−0.4912 (0.1445)**	RMSE	0.1134
investment	0.0407 (0.0063)***		
D1	−0.3408 (0.1521)*		
D2	−0.4913 (0.1369)***		
GDP:D1	0.0841 (0.0182)***		
investment:D1	−0.0189 (0.0048)***		
GDP:D2	0.0640 (0.0163)***		
GDP:I1	−0.0783 (0.0474)		

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Legend:

- D1 = [1983,1993) D2 = [1993,2003)
- R1 = Asia R2 = Africa
- I1 = high income
- I2 = low income

Results analysis 1: Conditional Convergence



Definition

conditional convergence principle: the lower the initial GDP the higher the growth over the next decade

Results analysis 2: Fertility Coefficient

Asia / Middle Income

$$\hat{\beta}_1 = -0.4729$$

Europe / High Income

$$\hat{\beta}_1 = -0.0045$$

Prediction model: no dummies for decades

Let $\epsilon \sim N(0, \sigma^2)$

prediction model

$$Growth_{lm} = \beta_{0lm} + \beta_{1lm}\text{fertility} + \beta_2\text{FDI} + \beta_{3lm}\text{GDP} + \beta_4\text{education} + \beta_5\text{consumption} + \beta_6\text{inflation} + \beta_7\text{health} + \beta_{8lm}\text{investment}\epsilon$$

$$l \in \{\text{Asia}, \ \text{Africa}, \ \text{Others}\}$$

$$m \in \{\text{High Income}, \ \text{Medium Income}, \ \text{Low Income}\}$$

predictor evaluation

fitting sample = [1983,2013] test sample = [2003,2013]

Definition

- F_t = prediction for the growth in t with our model
- Y_t = realization of growth in t
- e_t = prediction error
- $ME = \sum_{t=0}^{n} \frac{1}{n} e_t$ = mean error
- $MAD = \sum_{t=0}^{n} \frac{1}{n} \|e_t\|$ = mean absolute deviation
- $RMSE = \sqrt{\sum_{t=0}^{n} \frac{1}{n} e_t^2} =$ root mean square error

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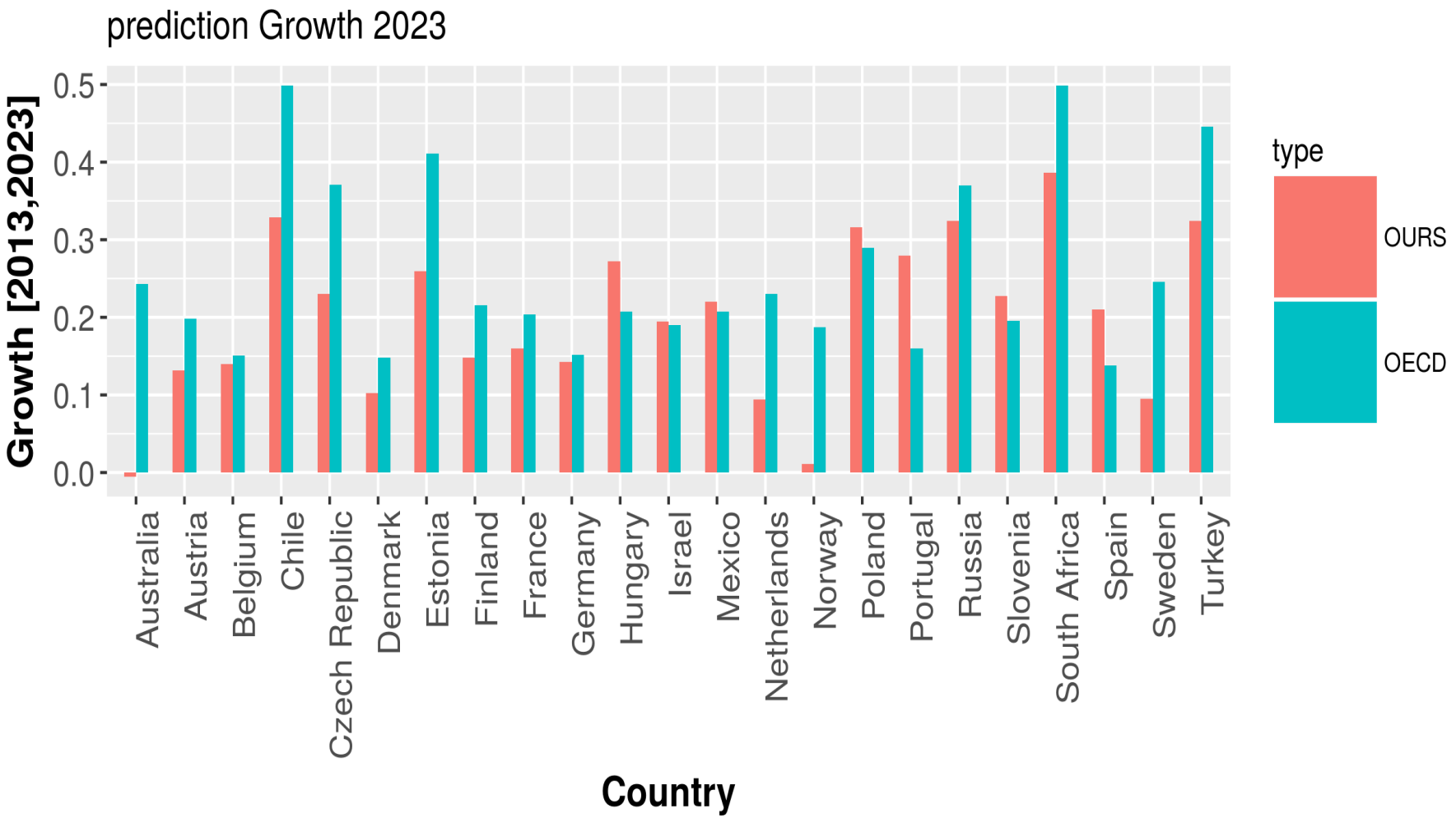
predictor performances

validation on $n = 12$ new countries

ME	MAD	RMSE
0.032	0.163	0.211

- slightly overestimating
- inaccurate out-of-sample

2023 growth prediction comparison



OECD = The Organisation for Economic Co-operation and Development is an intergovernmental economic organisation with 35 member countries, founded in 1960 to stimulate economic progress and world trade