

# **Regional Disparities in Educational Outcome, Spatial Spill-over, and the Determinants**

Evidence from 34 Provinces in Indonesia

Ragdad Cani Miranti

BPS- Central Bureau Statistics of Indonesia

Prepared for 2021 Asian Seminar in Regional Science

October 8th 2021

[slides available at: <https://asrs-slides-2021.netlify.app/#1>]

## Motivation:

- Regional disparities in educational outcomes still persist
- Financial resources have been intensified
- Government of Indonesia implemented the rule of 20 percent budgeting for educational funds.
- There are relative few studies that evaluate the role of spatial effects on the educational process.
- Lack of academic literature on educational development at the sub-national level in Indonesia.

## Research Question:

- Does role of neighborhood effect exist in altering the educational outcomes between proximate provinces?
- What are the significant variables affecting the educational outcomes across provinces?
- How is the magnitude of those variables and spill-over effects to the educational outcomes across provinces?

## Methods:

- Spatial autocorrelation (Moran's I and LISA)
- Spatial Panel Models (SAR,SEM,SAC,SDM region-fixed effect)

## Main Results:

1. Significant Spatial Autocorrelation at the province level.
2. Spatial model
  - Spatial Durbin Model is the best specification model
  - Number of educational institutions and pupil-teacher ratio are two key factors affecting educational outcomes across provinces in Indonesia
  - Number of educational institutions (elementary school and senior high school) have indirect effect to the educational outcome.
3. Policy Implication
  - Increasing spatially better coordination and cooperation on educational development connectivity between local governments especially in the Eastern part and outer islands
  - Improving educational infrastructures

# Outline of this presentation

1. Introduction and Data
2. Spatial autocorrelation
  - Moran's I Scatter Plot
  - Local Indicators of Spatial Autocorrelation
3. Spatial Panel Model
  - Cross-sectional dependence test in the panel data
  - OLS Fixed Effect vs Some Spatial Panel Model with Region Fixed-Effect
  - Direct and Indirect Effect
4. Concluding Remarks

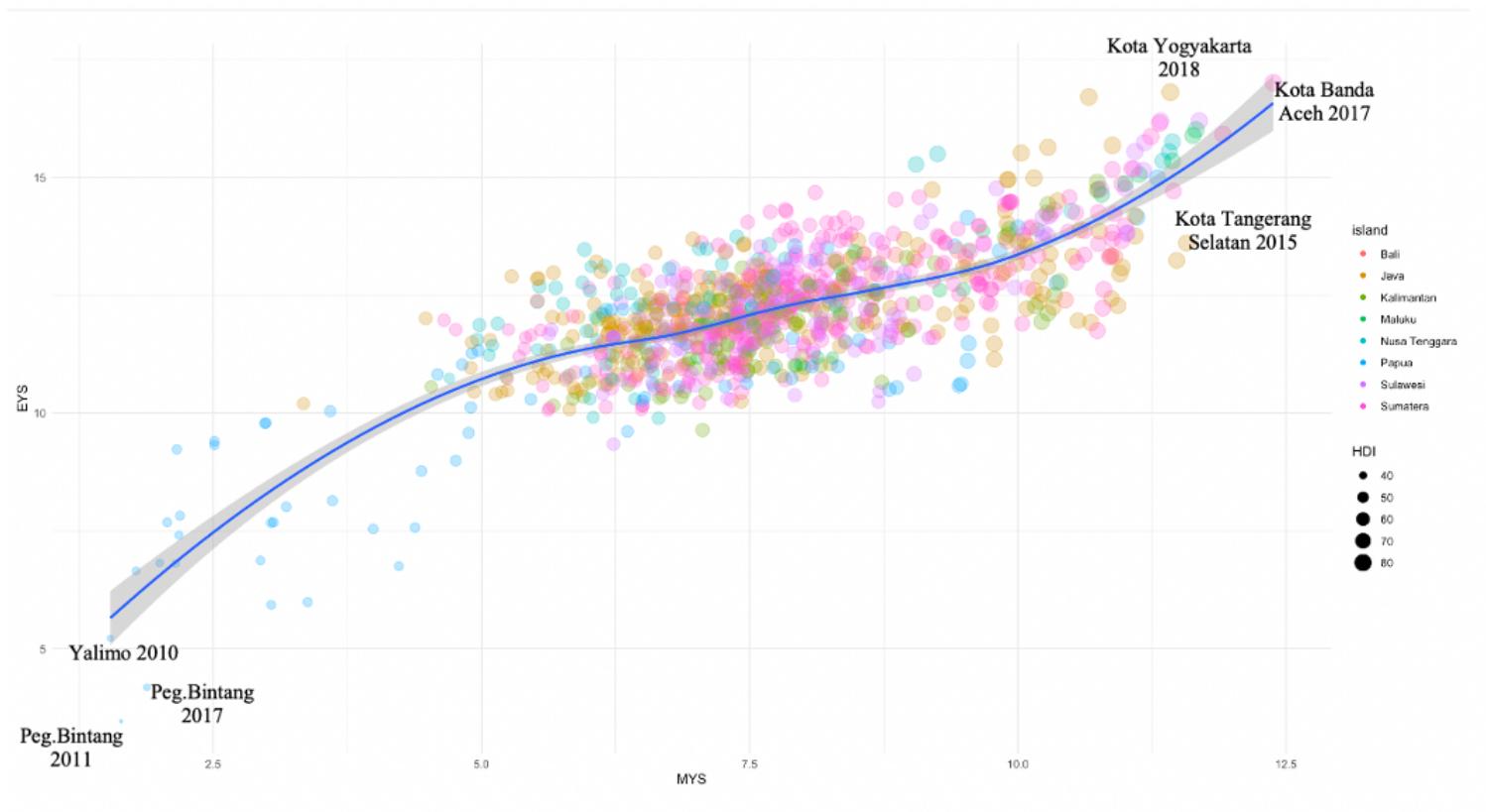
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## **(1) Some stylized facts**

Educational Outcome disparities across districts over time

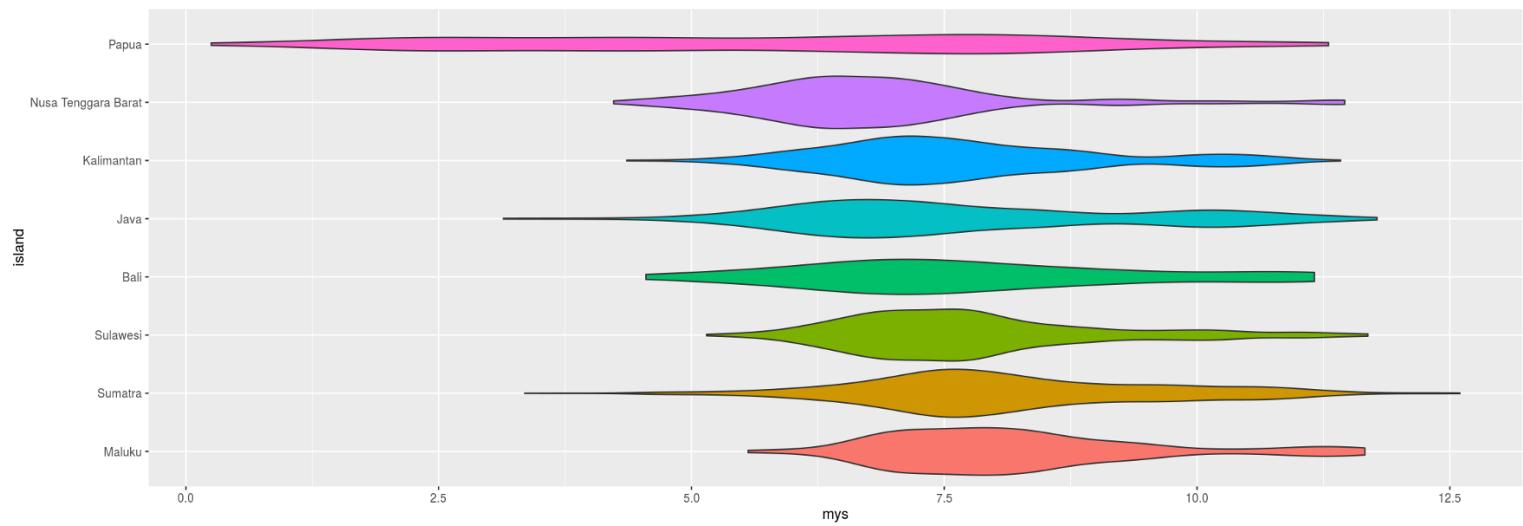
Educational Outcome disparities across islands over time

# Disparities in mean years of schooling across districts over time



Note: X-axis reflects mean years of schooling, Y-axis reflects expected years of schooling, human development index is reflected by the dot size and name of island is reflected by the dot color

# Violin Chart of Mean Years Schooling Dispersion across Islands in Indonesia



## (1) Data

Mean years of schooling 2010-2018 at province level

Expected years of schooling 2010-2018 at province level

Number of elementary schools, junior high schools, and senior high schools 2010-2018 at province level

Pupil-teacher ratio in elementary school, junior high school, and senior high school

All data are derived from Central Bureau Statistics of Indonesia (BPS-Statistics Indonesia)

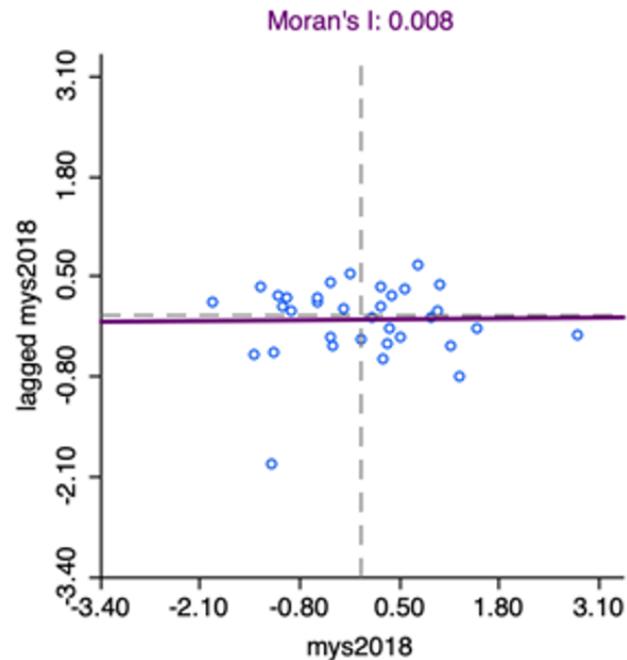
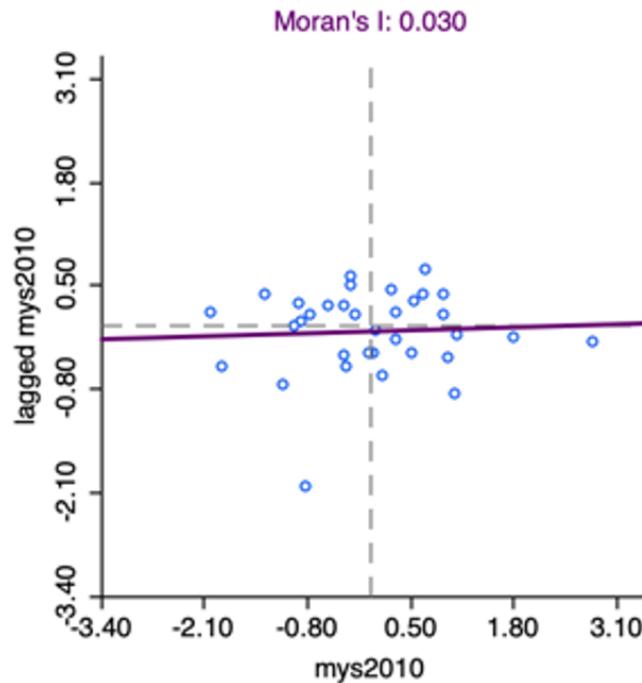
## (3) Spatial Autocorrelation

Global Spatial Autocorrelation : Moran's I Statistics

Local Indicators of Spatial Autocorrelation (LISA)

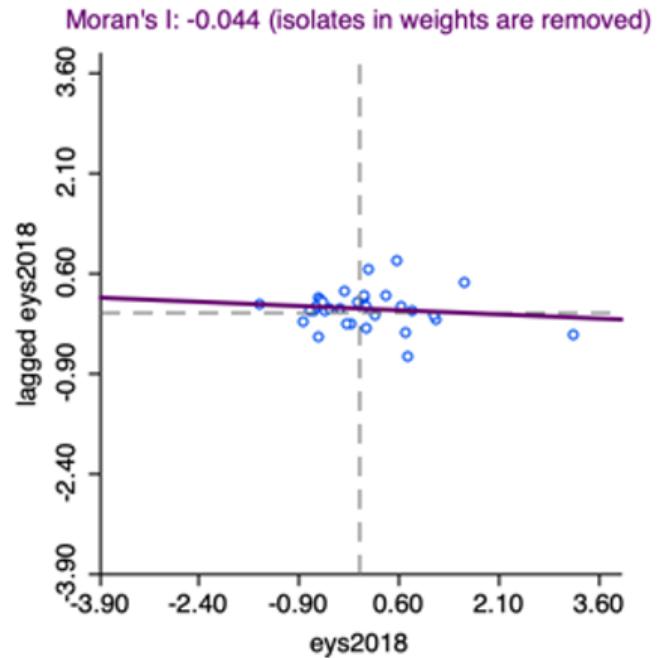
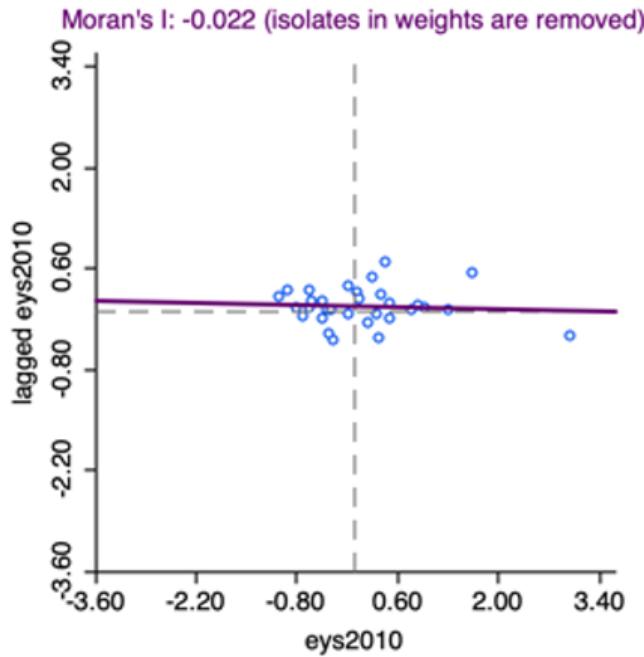
# Global spatial Autocorrelation

## Mean Years of Schooling



Global spatial autocorrelation is measured based on the Moran's I, which is statistically significant at 5% level for all years.

## Expected Years of Schooling



# Local Indicators of Spatial Autocorrelation (LISA)

Mean Years of Schooling Initial period (2010)



Note : Local spatial dependence is significant for both spatial clusters and spatial outliers at 5% significance level

# Local Indicators of Spatial Autocorrelation (LISA)

Mean Years of Schooling Initial period (2018)



\*\*Significant cold-spot (spatial cluster with low mean years of schooling surrounded by low mean years of schooling-cluster) located in Papua Province.

# Local Indicators of Spatial Autocorrelation (LISA)

Expected Years of Schooling Initial period (2010)



Note : Local spatial dependence is significant for both spatial clusters and spatial outliers at 5% significance level

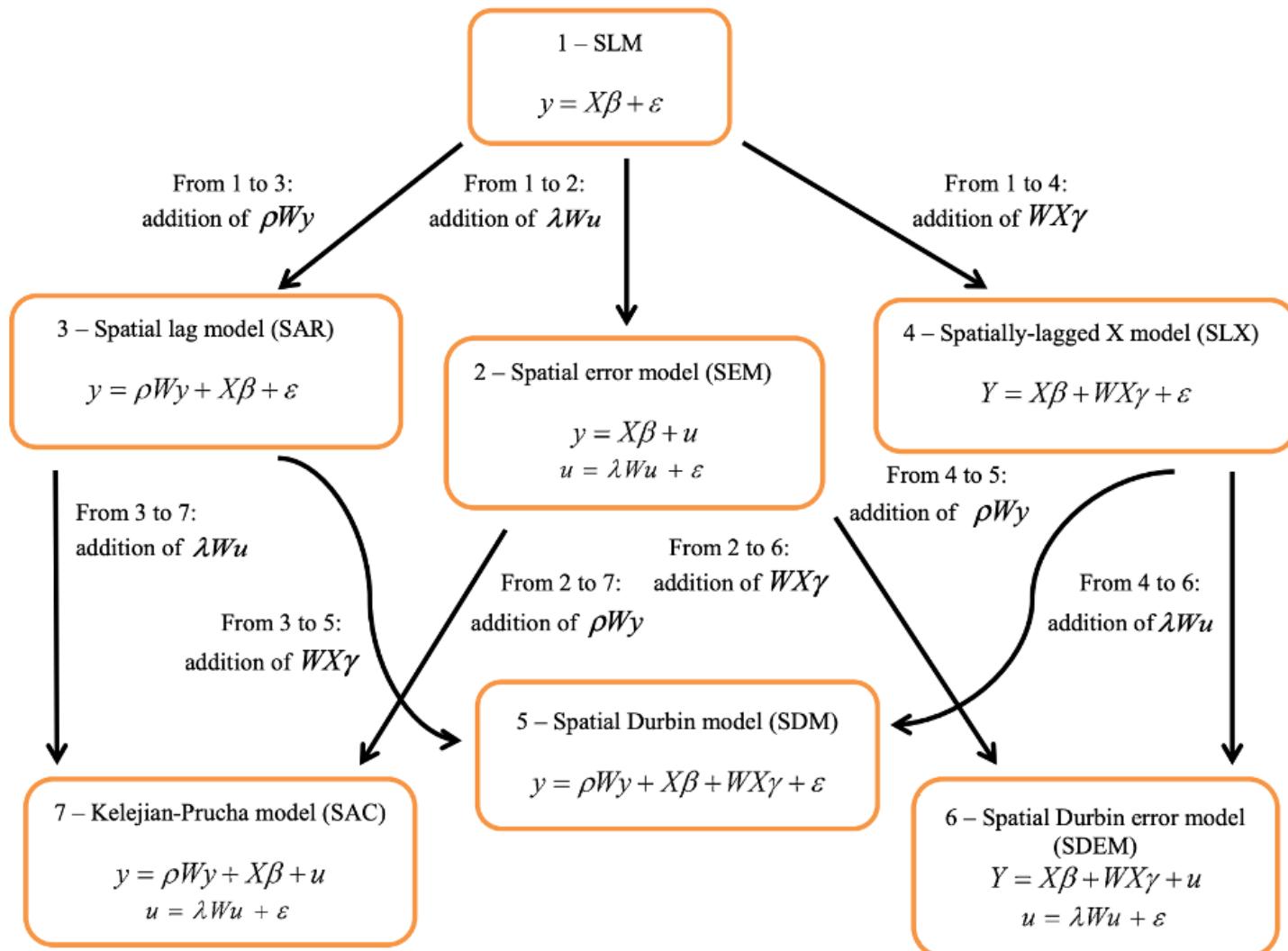
# Local Indicators of Spatial Autocorrelation (LISA)

Expected Years of Schooling Initial period (2018)



Spatial outlier high-low (spatial cluster with relatively high expected years of schooling surrounded by relatively low expected years of schooling cluster) is only significant in Maluku Province.

# Some Spatial Panel Models



# Cross-sectional dependence test in the panel data model

## Pesaran Test for Model of Mean Years of Schooling

Pesaran's test of cross sectional independence = **33.987**, Pr = **0.0000**

Average absolute value of the off-diagonal elements = **0.576**

## Pesaran Test for Model of Expected Years of Schooling

Pesaran's test of cross sectional independence = **22.938**, Pr = **0.0000**

Average absolute value of the off-diagonal elements = **0.535**

# Spatial Panel Models for Mean Years of Schooling

## Spatial Panel Model with Region Fixed-Effect

Variable	OLS	SLM	SEM	SAC	SDM
Number of observations	306	306	306	306	306
Educational expense	0.000	0.000	0.000	0.000	0.000
Number of primary (elementary) schools	-0.000	0.000	0.000	0.000	-0.000
Pupil-teacher ratio (elementary school)	-0.004	0.006**	0.007**	0.007**	0.008**
Number of junior high schools	0.0003***	0.0001	0.0001	0.0001	0.0001
Pupil-teacher ratio (junior high school)	-0.008**	-0.004**	-0.003***	-0.003*	-0.004***
Number of senior high schools	0.001**	-0.0001	-0.0001	-0.0001	-0.000
Pupil-teacher ratio (senior high school)	0.003	-0.004*	-0.0061**	-0.006***	-0.006**
Constant	6.987***				
Goodness of Fit Test					
R2 within	0.635	0.722	0.235	0.075	0.906
R2 between	0.02	0.021	0.036	0.047	0.006
R2 overall	0.044	0.017	0.021	0.031	0.052
AIC	-250.49	-685.13	-673.9	-679.46	-687.82
BIC	-220.71	-651.62	-640.39	-642.22	-628.25

# Spatial Autocorrelation Parameter

Variable	OLS	SLM	SEM	SAC	SDM
Spatial rho (SLM)		0.901*** (0.022)			
Spatial Lambda (SEM)			0.948*** (0.013)		
Spatial rho (SAC)				-0.865*** (0.301)	
Spatial Lambda (SAC)				0.975*** (0.008)	
Spatial Cross-regressive (SDM)					0.781*** (0.051)

# Spatial Panel Models for Expected Years of Schooling

## Spatial Panel Model with Region Fixed-Effect

Variable	OLS	SLM	SEM	SAC	SDM
Number of observations	306	306	306	306	306
Educational expense	0.000***	0.000	-0.000**	-0.000**	-0.000***
Number of primary (elementary) schools	0.0001	0.0003***	0.000***	0.0003***	0.0002***
Pupil-teacher ratio ( elementary school)	-0.054***	-0.012**	-0.012**	-0.011*	-0.014**
Number of junior high schools	0.001***	0.0002**	0.0002**	0.000***	0.000*
Pupil-teacher ratio (junior high school)	-0.018**	-0.006*	-0.007**	-0.006***	-0.006
Number of senior high schools	0.001**	0.000	-0.000	-0.000	0.000
Pupil-teacher ratio (senior high school)	0.009	-0.003	-0.005	-0.005	-0.006
Constant	10.231***				
Goodness of Fit Test					
R2 within	0.724	0.756	0.026	0.014	0.936
R2 between	0.075	0.756	0.089	0.087	0.090
R2 overall	0.128	0.106	0.065	0.063	0.150
AIC	150.14	-270.76	-264.52	-268.16	-278.16
BIC	179.93	-237.25	-231.01	-230.92	-231.92

## Spatial Autocorrelation Parameter

Variable	OLS	SLM	SEM	SAC	SDM
Spatial rho (SLM)		0.902*** (0.022)			
Spatial Lambda (SEM)			0.953*** (0.011)		
Spatial rho (SAC)				-0.758** (0.309)	
Spatial Lambda (SAC)				0.975*** (0.008)	
Spatial Cross-regressive (SDM)					0.670*** (0.066)

# Direct and Indirect Effect

## Mean Years Schooling

sd = Number of elementary schools Ratio\_sd = Pupil-teacher ratio ( elementary school)

smp = Number of junior high schools Ratio\_smp = Pupil-teacher ratio (junior high school)

sma = Number of senior high schools Ratio-sma = Pupil-teacher ratio (senior high school)

LR_Direct						
edu_exp	3.57e-08	1.25e-06	0.03	0.977	-2.42e-06	2.49e-06
sd	-.0000659	.0000619	-1.06	0.287	-.0001872	.0000555
ratio_sd	.0086195	.0034205	2.52	0.012	.0019154	.0153235
smp	.0000546	.000062	0.88	0.379	-.000067	.0001762
ratio_smp	-.0047665	.0024132	-1.98	0.048	-.0094962	-.0000368
sma	.000298	.0001947	1.53	0.126	-.0000837	.0006797
ratio_sma	-.0053169	.0028763	-1.85	0.065	-.0109543	.0003206
LR_Indirect						
edu_exp	2.63e-06	.0000117	0.22	0.823	-.0000204	.0000256
sd	-.0017106	.0011379	-1.50	0.133	-.0039409	.0005196
ratio_sd	.0273693	.0455813	0.60	0.548	-.0619685	.116707
smp	-.0000672	.0009648	-0.07	0.944	-.0019581	.0018237
ratio_smp	-.0435176	.0457621	-0.95	0.342	-.1332097	.0461744
sma	.0106407	.0034114	3.12	0.002	.0039545	.0173268
ratio_sma	.0358926	.0392158	0.92	0.360	-.0409689	.1127542

# Direct and Indirect Effect

## Expected Years of Schooling

LR_Direct						
edu_exp	-6.25e-06	2.35e-06	-2.66	0.008	-.0000109	-1.64e-06
sd	.0001512	.000102	1.48	0.138	-.0000487	.0003512
ratio_sd	-.0148888	.0060996	-2.44	0.015	-.0268439	-.0029338
smp	.0001862	.0001078	1.73	0.084	-.0000252	.0003975
ratio_smp	-.0056865	.0039748	-1.43	0.153	-.0134769	.0021038
sma	.0004456	.0003322	1.34	0.180	-.0002056	.0010968
ratio_sma	-.0055118	.005129	-1.07	0.283	-.0155644	.0045408
LR_Indirect						
edu_exp	.0000282	.0000148	1.90	0.058	-9.08e-07	.0000572
sd	-.0041677	.0013722	-3.04	0.002	-.0068571	-.0014782
ratio_sd	-.0595544	.0557418	-1.07	0.285	-.1688064	.0496975
smp	.0003892	.0012424	0.31	0.754	-.0020459	.0028243
ratio_smp	.0072494	.056772	0.13	0.898	-.1040216	.1185204
sma	.0160817	.0043512	3.70	0.000	.0075534	.02461
ratio_sma	.0229269	.0495254	0.46	0.643	-.0741411	.1199949

## (5) Concluding Remarks

- **Inequality still matters.** Eastern part of Indonesia need to be the priority of educational development.
- The availability of educational institutions in each level and the pupil-teacher ratio are vital factors to improve the educational outcomes in Indonesia.
- **Spill-over effect does exist.** The indirect effect of availability of schools to the mean years of schooling and expected years of schooling is positive and significant.

# **Thank you very much for your attention**

Slides and working paper available at: <https://asrs-slides-2021.netlify.app/#1>

Quantitative Regional and Computational Science lab

<https://quarcs-lab.rbind.io>

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