Cost-benefit analysis of COVID-19 control measures in the Philippines and Indonesia

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This presentation

- Covers 2 studies:
  - National level analysis of COVID-19 control measures in the Philippines
  - City level analysis of COVID-19 control measures in Jakarta, Indonesia
- Methodology is similar, so it will be explained for the first study, while only scenarios/results will be presented for the second
- Objectives of both studies are:
  1. To use a more advanced epidemiological model than has been previously applied to simulate effects of measures
  2. To consider effects of measures in an economic framework that compares costs and benefits

Analysis of COVID-19 control measures for the Philippines

Age structured epidemiological model

Schools

Age of individual \ Age of contact	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79
0-4	0.32	0.23	0.04	0.03	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
5-9	0.29	7.89	0.40	0.03	0.02	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
10-14	0.00	1.55	9.93	0.19	0.02	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
15-19	0.01	0.05	1.88	5.40	0.04	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
20-24	0.01	0.02	0.01	0.45	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25-29	0.00	0.01	0.00	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30-34	0.00	0.04	0.02	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35-39	0.01	0.02	0.02	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
40-44	0.00	0.02	0.01	0.04	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
45-49	0.02	0.04	0.02	0.06	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
50-54	0.01	0.07	0.09	0.07	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
55-59	0.02	0.08	0.06	0.06	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
60-64	0.01	0.02	0.01	0.03	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
65-69	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
70-74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
75-79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Homes

Age of individual \ Age of contact	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79
0-4	0.67	0.66	0.47	0.26	0.41	0.80	0.77	0.60	0.26	0.17	0.21	0.23	0.27	0.15	0.11	0.13
5-9	0.51	0.93	0.80	0.32	0.19	0.51	0.63	0.66	0.45	0.22	0.16	0.21	0.22	0.15	0.14	0.11
10-14	0.26	0.60	1.10	0.73	0.23	0.18	0.28	0.48	0.58	0.40	0.19	0.12	0.15	0.14	0.16	0.09
15-19	0.10	0.24	0.68	1.02	0.53	0.21	0.10	0.29	0.42	0.56	0.35	0.20	0.10	0.11	0.07	0.09
20-24	0.16	0.11	0.14	0.66	1.11	0.62	0.14	0.05	0.15	0.47	0.42	0.30	0.14	0.04	0.08	0.08
25-29	0.50	0.28	0.13	0.22	0.75	1.04	0.37	0.11	0.06	0.16	0.45	0.34	0.28	0.11	0.05	0.07
30-34	0.84	0.77	0.48	0.12	0.17	0.55	0.67	0.42	0.15	0.12	0.15	0.21	0.27	0.12	0.10	0.08
35-39	0.66	1.02	0.76	0.39	0.16	0.16	0.32	0.55	0.28	0.12	0.13	0.12	0.29	0.23	0.12	0.07
40-44	0.28	0.59	0.97	0.85	0.41	0.18	0.18	0.30	0.45	0.28	0.18	0.08	0.20	0.17	0.15	0.17
45-49	0.15	0.25	0.51	0.95	0.71	0.29	0.12	0.17	0.20	0.52	0.33	0.13	0.11	0.10	0.11	0.19
50-54	0.25	0.16	0.24	0.52	0.60	0.56	0.21	0.13	0.11	0.23	0.55	0.41	0.19	0.08	0.12	0.16
55-59	0.20	0.23	0.19	0.29	0.43	0.52	0.35	0.14	0.09	0.20	0.34	0.76	0.34	0.18	0.05	0.12
60-64	0.29	0.21	0.16	0.18	0.24	0.36	0.38	0.24	0.16	0.09	0.16	0.47	0.78	0.41	0.14	0.04
65-69	0.15	0.28	0.22	0.14	0.11	0.19	0.22	0.25	0.22	0.11	0.13	0.16	0.47	0.70	0.33	0.11
70-74	0.12	0.14	0.19	0.27	0.11	0.24	0.07	0.26	0.25	0.27	0.17	0.13	0.14	0.58	0.68	0.50
75-79	0.15	0.12	0.19	0.19	0.07	0.24	0.16	0.17	0.19	0.08	0.29	0.22	0.10	0.28	0.28	0.79

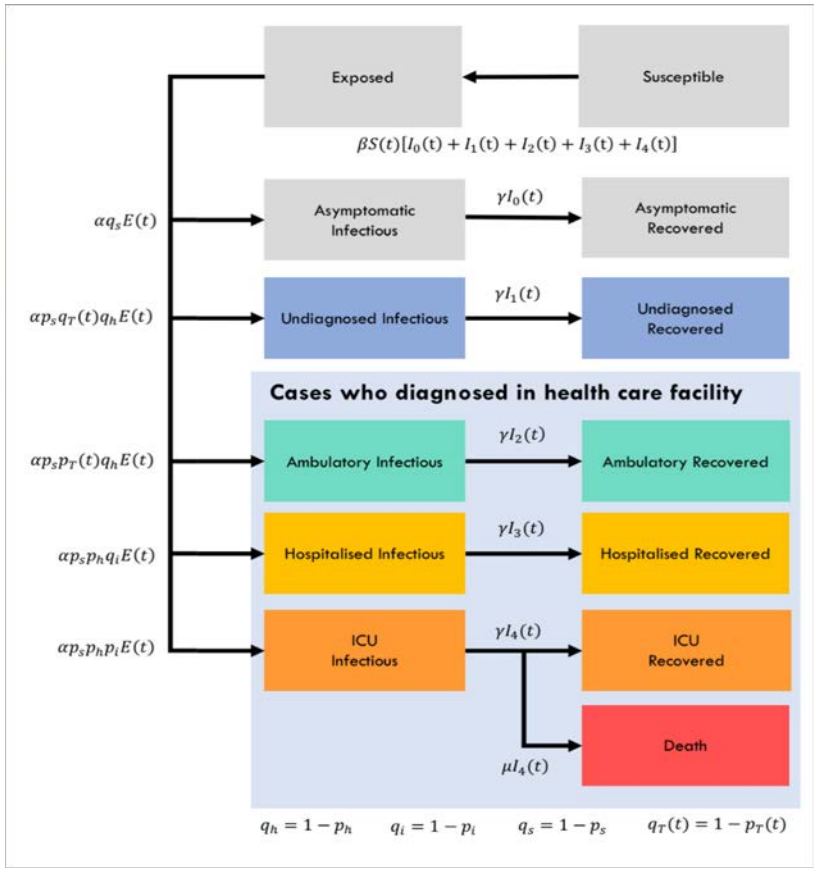
Other locations

Age of individual \ Age of contact	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79
0-4	0.79	0.34	0.18	0.14	0.25	0.4	0.5	0.44	0.33	0.24	0.3	0.27	0.21	0.18	0.12	0.06
5-9	0.39	1.49	0.56	0.16	0.14	0.3	0.4	0.46	0.42	0.21	0.17	0.2	0.21	0.15	0.08	0.06
10-14	0.12	0.66	2.39	0.39	0.27	0.24	0.3	0.37	0.47	0.31	0.21	0.14	0.11	0.12	0.09	0.08
15-19	0.07	0.22	1.04	3.28	0.82	0.41	0.28	0.34	0.39	0.36	0.17	0.09	0.08	0.07	0.05	0.03
20-24	0.09	0.12	0.18	1.2	2	0.84	0.54	0.37	0.31	0.38	0.24	0.17	0.08	0.06	0.07	0.06
25-29	0.14	0.07	0.07	0.28	0.81	1.1	0.67	0.47	0.34	0.32	0.28	0.16	0.07	0.05	0.04	0.02
30-34	0.12	0.09	0.14	0.12	0.32	0.49	0.67	0.49	0.34	0.27	0.28	0.22	0.12	0.08	0.05	0.05
35-39	0.1	0.12	0.09	0.07	0.17	0.33	0.44	0.55	0.42	0.28	0.2	0.17	0.17	0.12	0.08	0.03
40-44	0.07	0.09	0.14	0.1	0.18	0.23	0.34	0.38	0.45	0.29	0.2	0.1	0.11	0.08	0.07	0.03
45-49	0.02	0.03	0.04	0.08	0.12	0.15	0.2	0.23	0.25	0.26	0.21	0.11	0.09	0.06	0.06	0.05
50-54	0.02	0.05	0.05	0.08	0.16	0.21	0.17	0.17	0.21	0.25	0.2	0.17	0.12	0.06	0.05	0.03
55-59	0.03	0.03	0.03	0.04	0.1	0.17	0.19	0.17	0.18	0.13	0.2	0.2	0.15	0.08	0.05	0.03
60-64	0.02	0.02	0.02	0.03	0.07	0.12	0.13	0.17	0.16	0.13	0.12	0.17	0.17	0.12	0.1	0.04
65-69	0.02	0.02	0.01	0.02	0.05	0.08	0.11	0.1	0.11	0.09	0.1	0.12	0.13	0.11	0.07	0.04
70-74	0.01	0.01	0.02	0.03	0.03	0.05	0.05	0.08	0.1	0.08	0.07	0.07	0.14	0.12	0.13	0.05
75-79	0.01	0.01	0.01	0.01	0.01	0.02	0.04	0.03	0.03	0.04	0.03	0.03	0.04	0.05	0.05	0.03

Workplaces

Age of individual \ Age of contact	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79
0-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15-19	0	0	0	0.08	0.18	0.19	0.16	0.15	0.15	0.12	0.1	0.07	0.04	0.02	0	0
20-24	0	0	0	0.19	0.56	0.67	0.57	0.56	0.51	0.42	0.35	0.22	0.14	0.06	0	0
25-29	0	0	0	0.23	0.67	0.99	0.8	0.76	0.73	0.57	0.49	0.31	0.19	0.08	0	0
30-34	0	0	0	0.22	0.61	0.86	0.9	0.81	0.78	0.64	0.49	0.34	0.19	0.08	0	0
35-39	0	0	0	0.25	0.62	0.89	0.84	0.94	0.93	0.71	0.58	0.34	0.18	0.08	0	0
40-44	0	0	0	0.24	0.66	0.91	0.89	0.89	0.99	0.82	0.66	0.36	0.21	0.09	0	0
45-49	0	0	0	0.25	0.6	0.83	0.83	0.83	0.84	0.77	0.59	0.38	0.19	0.09	0	0
50-54	0	0	0	0.23	0.58	0.83	0.81	0.79	0.91	0.83	0.7	0.43	0.2	0.08	0	0
55-59	0	0	0	0.21	0.52	0.71	0.72	0.68	0.75	0.61	0.57	0.41	0.2	0.08	0	0
60-64	0	0	0	0.16	0.41	0.57	0.53	0.53	0.55	0.5	0.42	0.33	0.15	0.07	0	0
65-69	0	0	0	0.12	0.3	0.42	0.36	0.29	0.33	0.28	0.26	0.18	0.11	0.05	0	0
70-74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
75-79	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Age specific contact patterns (numbers of contacts per person) for the Philippines. Darker intensity indicates more daily contacts between that pair of ages at the location specified. “Other locations” is all locations not at home, school or work.



Epidemiological model structure

Source: Authors’ estimates.

Steps in the analysis

Building the epidemiological model*

- Projecting better representation of work, school, rural/urban, and household contacts by Region
- Reflecting severity and treatment needs by age

Running the scenarios

- Building scenarios comparing options
- Modeling of infection, treatment and mortality

Valuing costs and benefits

- Costing measures and valuing morbidity/ mortality changes

Evaluating non-COVID health outcomes

- Estimating effects of educational closure on mortality

*Age-structured susceptible-exposed-infectious-recovered model, with compartments for subclinical, clinical undiagnosed, clinical diagnosed, hospitalized, and ICU treated cases.

Scenarios considered for the Philippines

Scenario group	No.	Scenario	Existing/ anticipated policies thru 15 November	New normal after existing policies	Expanded tracing, testing, isolation (50% of cases)	Paid sick leave (50% covered)	School face to face closure until July 2021 (all levels)	School face to face closure until July 2021 (> =15 year olds)	School face to face closure until July 2021 (<15 year olds)
No new normal	S01	No action baseline							
	S02	Announced policies released	√						
	S03	Increased tracing+	√		√				
	S04	Paid sick leave	√			√			
New normal - comparing school policies	S05	"New normal" post lockdown	√	√					
	S06	School closure under "new normal"	√	√			√		
	S07	Upper school closure under "new normal"	√	√				√	
	S08	Lower school closure under "new normal"	√	√					√
New normal plus expanded testing, tracing and isolation and/or paid sick leave	S09	Increased tracing+ under "new normal"	√	√	√				
	S10	School closure plus tracing+ under "new normal"	√	√	√		√		
	S11	Paid sick leave under "new normal“	√	√		√			
	S12	School closure plus paid sick leave under "new normal"	√	√		√	√		
	S13	Paid sick leave plus tracing+ under "new normal"	√	√	√	√			

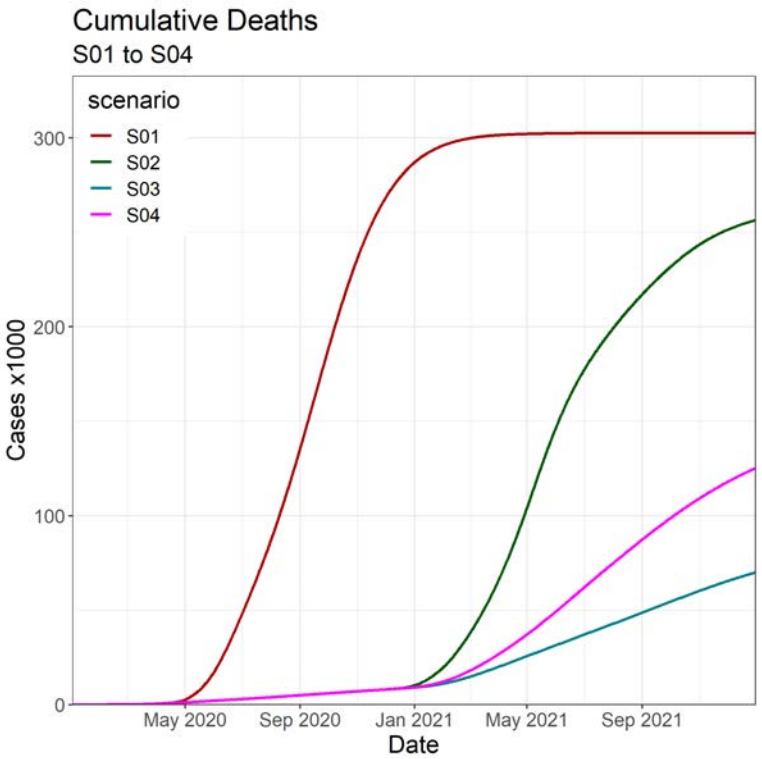
Social contact modifiers for scenarios (% of baseline)

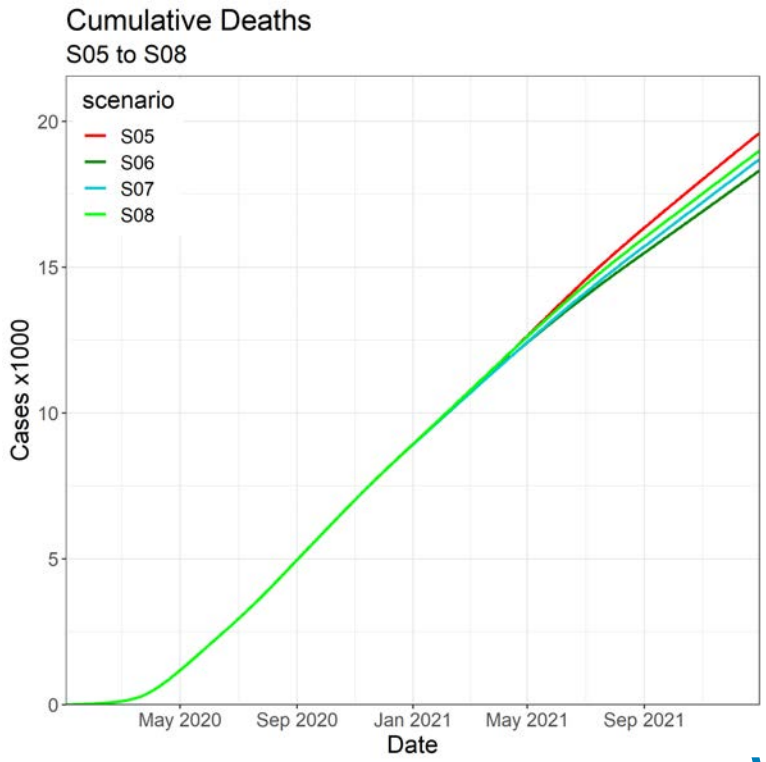
Intervention	Age	Location	Multiplier
ECQ	0-19	households	165
ECQ	20-64	households	155
ECQ	65-99	households	165
ECQ	0-19	Workplaces	0
ECQ	20-64	workplaces	19
ECQ	65-99	workplaces	0
ECQ	0-19	schools	0
ECQ	20-64	schools	0
ECQ	65-99	schools	0
ECQ	0-19	others	15
ECQ	20-64	others	30
ECQ	65-99	others	15
SSD	0-19	households	110
SSD	20-64	households	120
SSD	65-99	households	130
SSD	0-19	workplaces	70
SSD	20-64	workplaces	70
SSD	65-99	workplaces	0
SSD	0-14	schools	70 (0)
SSD	15-19	schools	70 (0)
SSD	20-64	schools	0
SSD	65-99	schools	40
SSD	0-14	others	42 (60)
SSD	15-19	others	20 (60)
SSD	20-64	others	110
SSD	65-99	Others	120

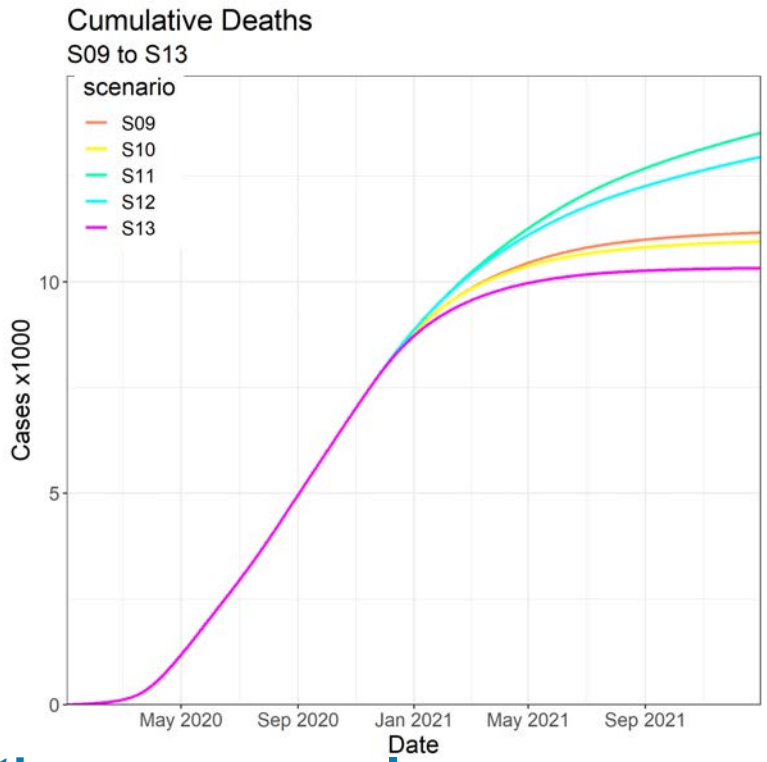
- Each scenario period has a set of contact rate modifiers (examples at left)
- Inverse relationship between home and non-home contact rates
- Increase in other contacts as work contacts resume
- School age child contacts outside home/school partially resume as parents go back to work, even if schools are closed

Values in parentheses applied in school closure scenarios.

Outcomes of the scenarios







Source: Authors' estimates.

- Releasing all measures causes the epidemic to return (S1 vs S2).
- Testing (S3) or paid sick leave (S4) alone lead to some reductions.
- Maintaining the new normal reduces death dramatically (S05).
- Closing schools -> a smaller difference, mostly in Q2+ 2021 (S06 vs. S05).
- Closing only schools for those over 15 (S07) averts most death, as most risk is from 15+ students (S08).

With a new normal

- Tracing, testing, and isolating 50% of cases leads to less death with schools open (S09) than in S06.
- Paid sick leave leads to less death than closing schools (S11 vs S06).
- Sick leave with testing (S13) leads to fewer cases than testing or leave plus school closure (S10 and S12).

Costs and benefits considered

1. **Costs**
   a. Economic costs of restrictions
   b. Losses due to school face to face closure
   c. Preventive health costs
   d. Economic costs of paid sick leave
2. **Benefits**
   a. Savings of life years multiplied with the value of statistical life per year*
   b. Treatment costs reduced and productivity losses averted

Costs and benefits are all netted against S02, as costs to date are sunk.

*160 times GNI

Steps in deriving losses of value added

1. **Supply reduction**
   a. Labor reduction drives effects
      a. Accounts for reduction in workers on site (IATF guidance)
      b. Accounts for work from home capabilities in each sector (ONet survey and PHL context).
   b. Economic activity follows a L^(output elasticity) calculation, where labor share approximate the elasticity.
2. **Demand reduction**
   a. Demand is reduced due to consumer's desire to avoid infection (CBO, 2006).
   b. Demand reduction diminishes over time from severe case (simulating 1918 flu) to mild case (simulating 1957 and 1968 pandemics) because consumers gradually becomes desensitized.
3. **Greater of supply or demand reduction is applied per period per scenario**

Economic Activity Reduction Relative to GDP from Restrictions

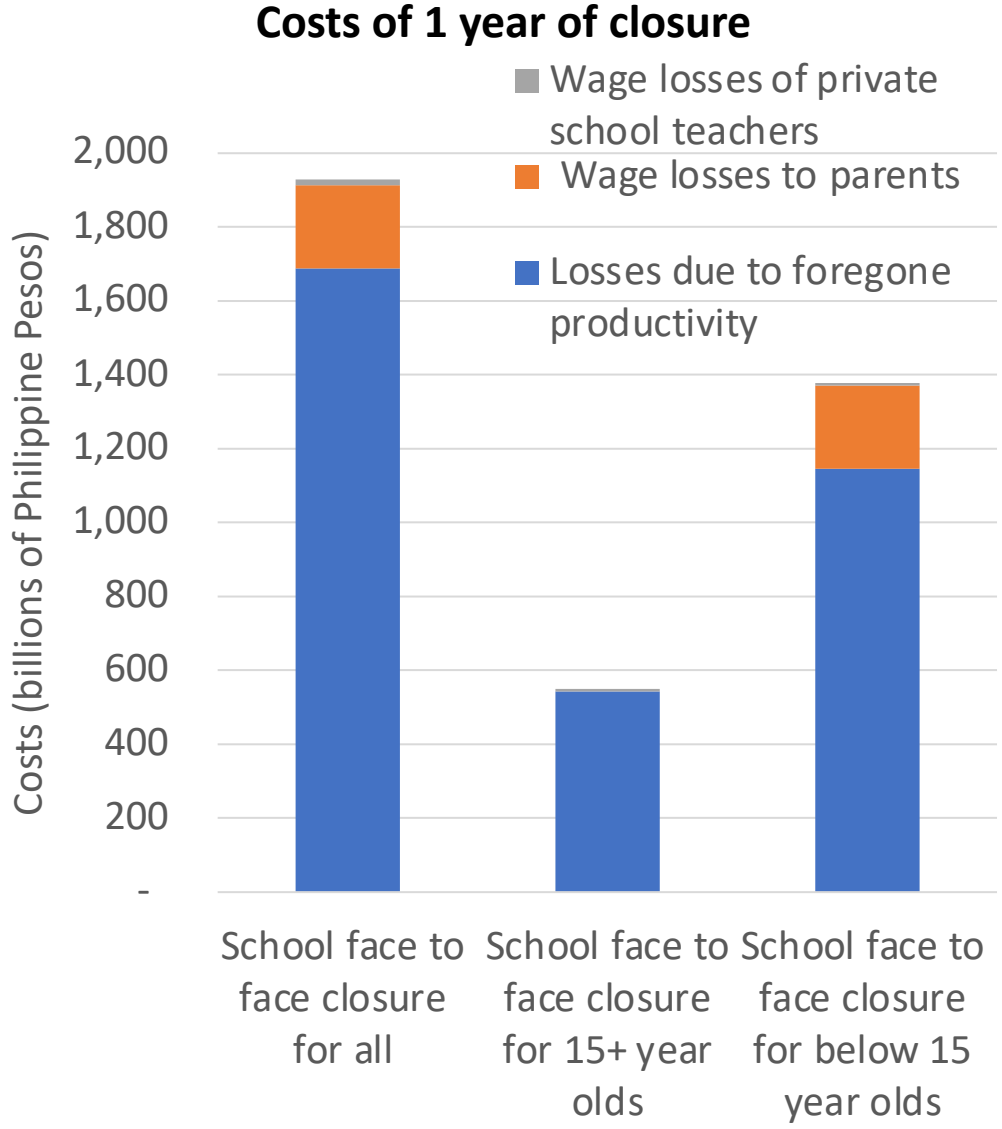
Code	2020	2021
S01	5.47%	2.95%
S02	15.16%	2.95%
S03	15.16%	2.95%
S04	15.16%	2.95%
S05	15.80%	6.35%
S06	15.80%	6.35%
S07	15.80%	6.35%
S08	15.80%	6.35%
S09	15.80%	6.35%
S10	15.80%	6.35%
S11	15.80%	6.35%
S12	15.80%	6.35%
S13	15.80%	6.35%

Source: Authors' estimates.

Losses due to face-to-face schooling closure

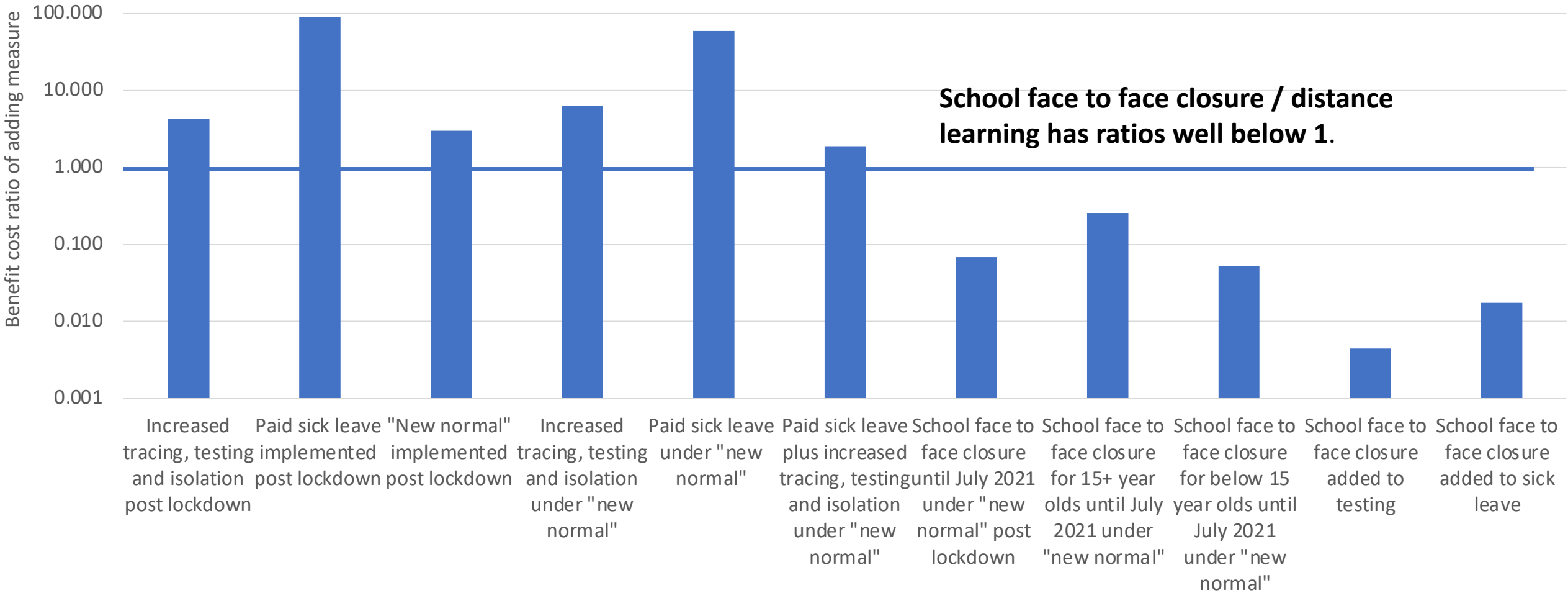
- Productivity of workforce
  - Reduction in effective education approximated by considering household characteristics of schoolchildren using FIES 2015
  - Returns to education identified using Mincer regression of LFS 2018 data
  - Coefficients used in model of future wages lost (3% discounting)
- Loss of income for parents to stay home
  - Wage losses for households where both parents are working and not living with an educated grandparent*.
- Loss of teacher income from private schools
  - Assuming 30% of private school teachers lose jobs*
- Costs sum to 1.9 trillion pesos for SY2020/21
  - Costs are 2.6 trillion pesos if enrollment drops permanently by 5%
- *Costs in the benefit cost analysis are pro-rated to period of 15 November 2020 to 30 April 2021*

*Analyses using FIES 2015.



Source: Authors' estimates.

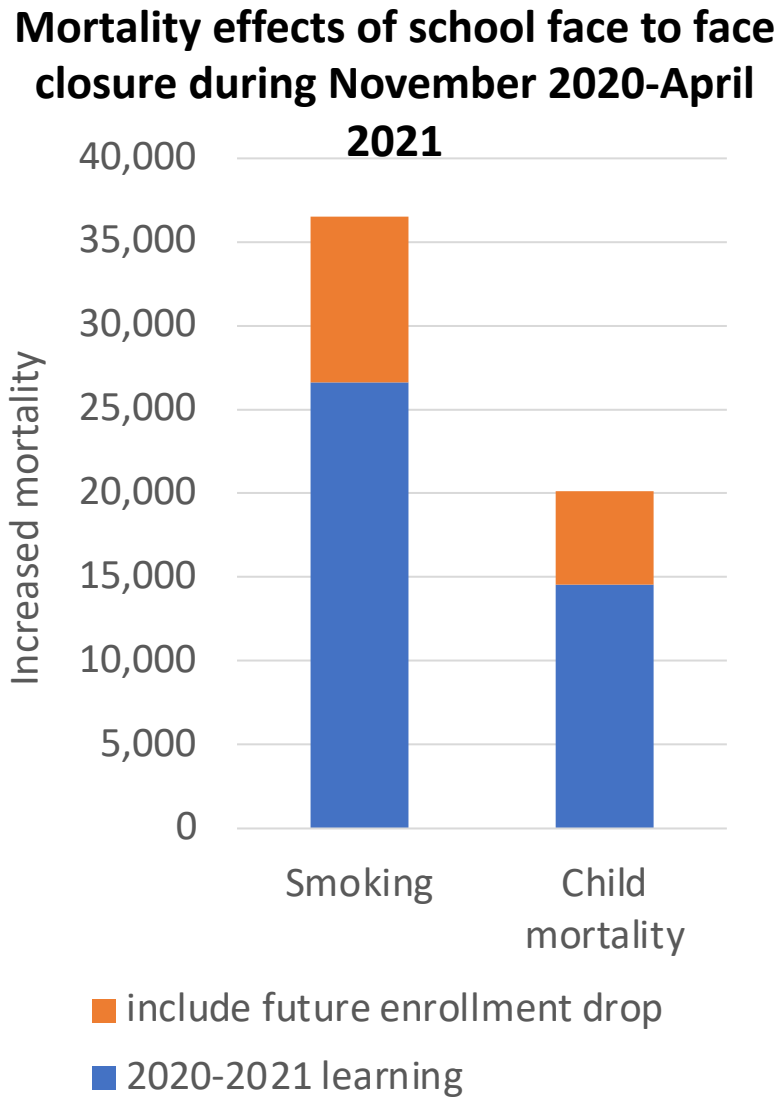
Marginal benefits/costs of adding individual measures



Source: Authors' estimates.

Side effects: school face to face closure and long-term mortality

- Education has strong effects on health behavior beyond COVID-19
- Regressions* used to determine effects of:
  - Education on smoking
  - Maternal education on child mortality
- Effects of reduced education from school closures used in models of current students when adults
- Results suggest that long term increased mortality from school closure may be 10 times to 100 times higher than the number of lives saved from COVID-19 (assuming the new normal is maintained).



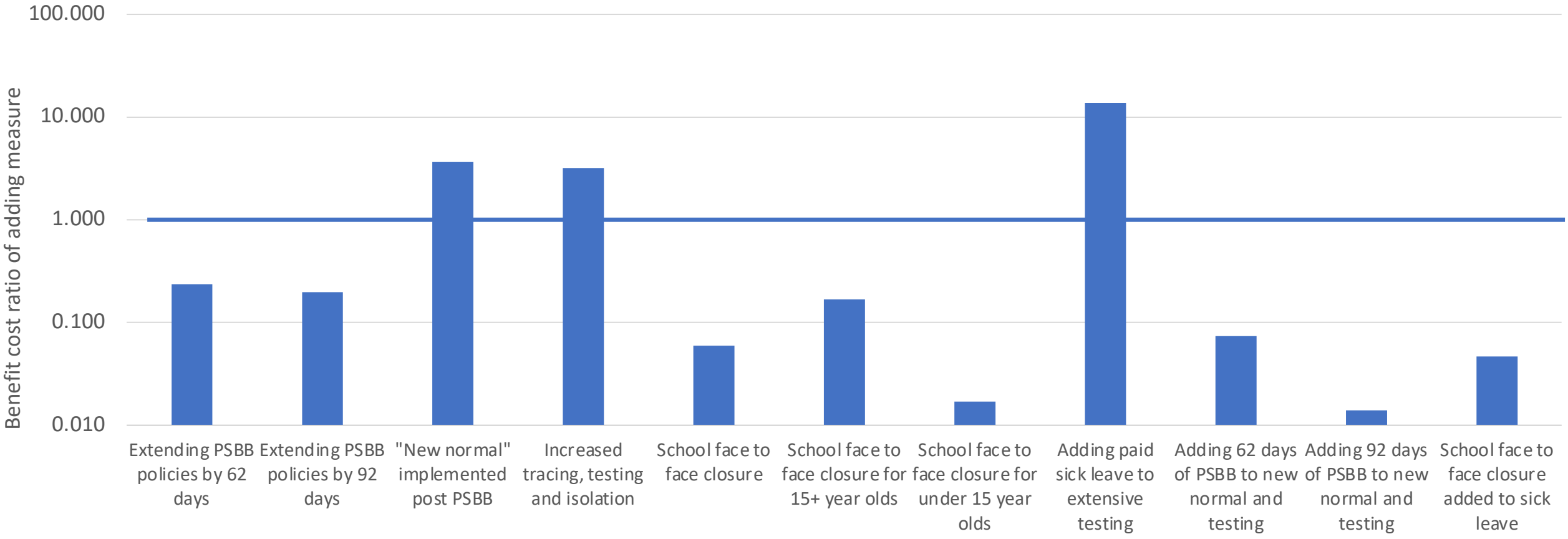
*Applied to microdata from FIES 2015 for smoking and DHS 2017 for child mortality

Source: Authors' estimates.

Analysis for Jakarta, Indonesia: Scenarios considered

Scenario group	No.	Scenario	New normal after existing policies	Extend PSBB to mid November	Extend PSBB to mid December	Expanded tracing, testing, isolation (50% of cases)	Paid sick leave (50% covered)	School face to face closure until July 2021 (all levels)	School face to face closure until July 2021 (specific levels)
No new normal	S01	No action baseline							
	S02	Announced policies released at expiration							
	S03	31 days PSBB + 31 Days Transisi		√					
	S04	62 days PSBB + 30 days transisi			√				
New normal	S05	"New normal" implemented post lockdown	√						
New normal plus expanded testing, tracing and isolation and/or paid sick leave	S06	Increased tracing, testing and isolation under "new normal"	√			√			
	S07	School face to face closure until July 2021 under "new normal" post lockdown	√			√		√	
	S08	School face to face closure for 15+ year olds until July 2021 under "new normal"	√			√			√
	S09	School face to face closure for below 15 year olds until July 2021 under "new normal"	√			√			√
	S10	Paid sick leave implemented post lockdown for 50% of workers	√			√	√		
	S11	31 days PSBB + 31 Days Transisi in "new normal"	√	√		√			
	S12	62 days PSBB + 30 days transisi in "new normal"	√		√	√			
	S13	School face to face closure until July 2021 plus increased tracing, testing and isolation and paid sick leave under "new normal"	√			√	√	√	

Marginal benefits/costs of adding individual measures in Jakarta



Source: Authors' estimates.

Conclusions

- Extended lockdowns only delay new waves if there is a return to normal before widespread vaccination
- School closures have higher costs than benefits and lead to substantial adverse indirect health effects
- Most important measures to keep COVID-19 contained over the long term are:
  - Ensuring a new normal can be sustained by mainstreaming social distancing into all activities and behavior, keeping leisure transmission limited
  - Investing in contact tracing, testing, and isolation
  - Setting incentives for self isolation of possible cases through paid sick leave
    - Also emerging empirical evidence of strong interaction effect of sick leave with contact tracing on effective reproductive rate

Thank you!

Supplemental slides

What is a contact matrix?

- A contact matrix is a matrix of the average frequency of contact events between individuals in age groups in the population
- Contact events are any types of interactions that can result in disease transmission - conversations, physical contact, and other social interaction
- Contact matrices are usually based on diaries in which sampled individuals need to record all the people they have been in contact with over a period of time
- These types of surveys need careful administration and have only been conducted in some countries. Indonesia has not had such a survey conducted.
- POLYMOD is the most frequently cited such study, conducted in a range of developed countries
- Prem et al. (2017 and 2020) projects POLYMOD contact matrices to countries around the world, taking into account demographic differences

Going further on contact matrices

- Contacts can be considered as “social” (friendships) or as part of non-social routine interaction (e.g. classmates, customers, seating neighbors)
- Diary based contact matrices have been found to give good depiction of core social contacts, but they also miss many routine contacts
- We adjusted the contact matrices to take into account these “routine” contacts
- For schooling, we considered the social contact implications of seating densities, in terms of neighbors within 2 meters
- For work, we considered routine contacts as a function of numbers of face to face interactions per occupation and the distance between people for the occupation
- For other locations, we used a regression based adjustment for rural/urban differences
- For homes, we adjusted for numbers of members in each age groups from POLYMOD estimates

Key assumptions

- Following Davies et al. (2020):
  - Children are mostly subclinical when infected
  - Children have somewhat lower susceptibility

- Subclinical cases are 40% as infectious as clinical (Ferretti et al. 2020, Jiang et al. 2020 and others even find lower values)

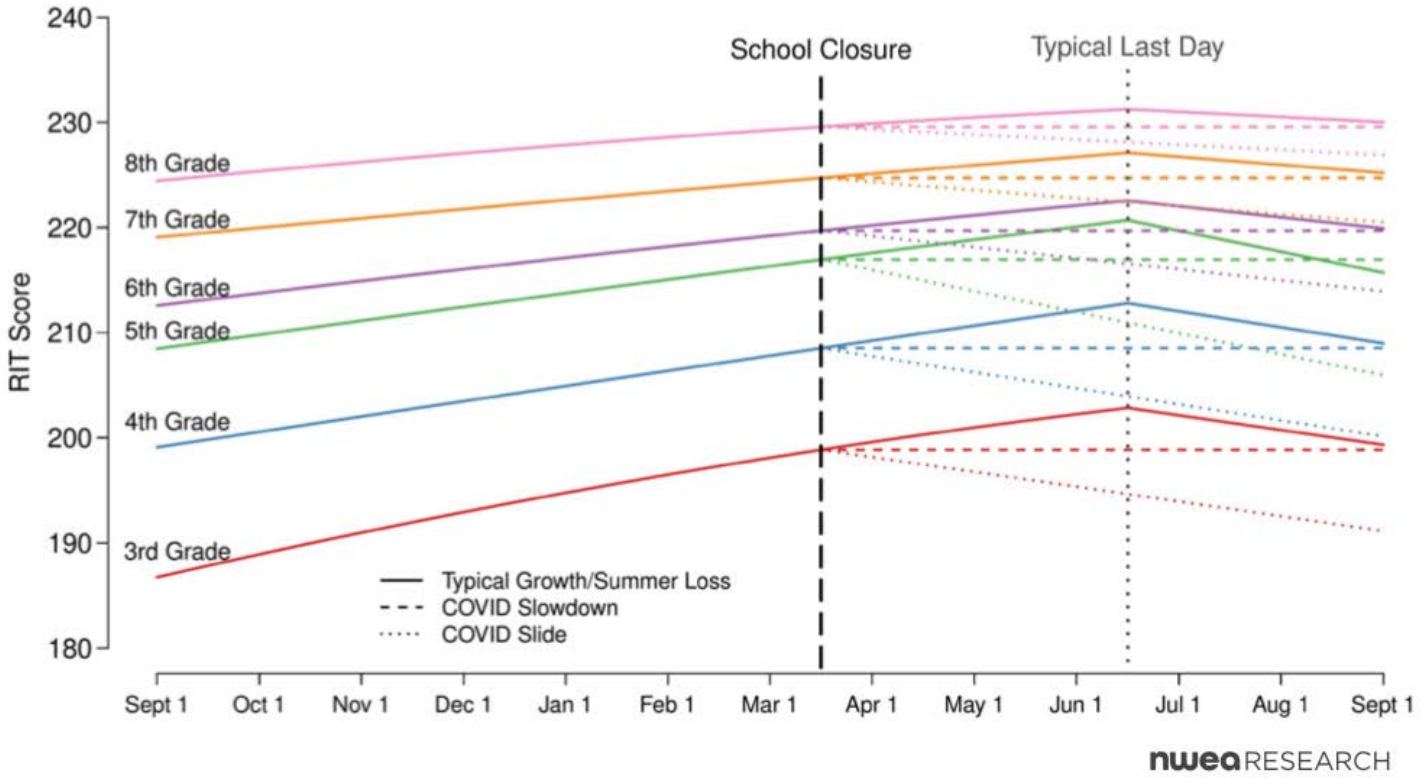
Susceptibility and clinical fraction by age

Parameter	Age Group	Mean	Quantile 2.5%	Quantile 25%	Quantile 50%	Quantile 75%	Quantile 97.5%
Susceptibility	0-9	0.4	0.25	0.34	0.39	0.45	0.57
Susceptibility	10-19	0.38	0.27	0.33	0.38	0.42	0.53
Susceptibility	20-29	0.79	0.59	0.72	0.79	0.86	0.96
Susceptibility	30-39	0.86	0.69	0.81	0.87	0.92	0.98
Susceptibility	40-49	0.8	0.61	0.74	0.80	0.86	0.96
Susceptibility	50-59	0.82	0.63	0.76	0.82	0.88	0.97
Susceptibility	60-69	0.88	0.70	0.83	0.89	0.93	0.99
Susceptibility	70+	0.74	0.56	0.68	0.74	0.80	0.90
Clinical fraction	0-9	0.29	0.18	0.25	0.28	0.33	0.44
Clinical fraction	10-19	0.21	0.12	0.17	0.20	0.24	0.31
Clinical fraction	20-29	0.27	0.18	0.23	0.26	0.30	0.38
Clinical fraction	30-39	0.33	0.24	0.29	0.33	0.36	0.43
Clinical fraction	40-49	0.4	0.28	0.36	0.40	0.44	0.52
Clinical fraction	50-59	0.49	0.37	0.45	0.49	0.53	0.60
Clinical fraction	60-69	0.63	0.49	0.59	0.63	0.68	0.76
Clinical fraction	70+	0.69	0.57	0.65	0.69	0.74	0.82

Source: Davies et al. (2020)

School closure means that students rapidly lose prior learning

Mathematics forecast



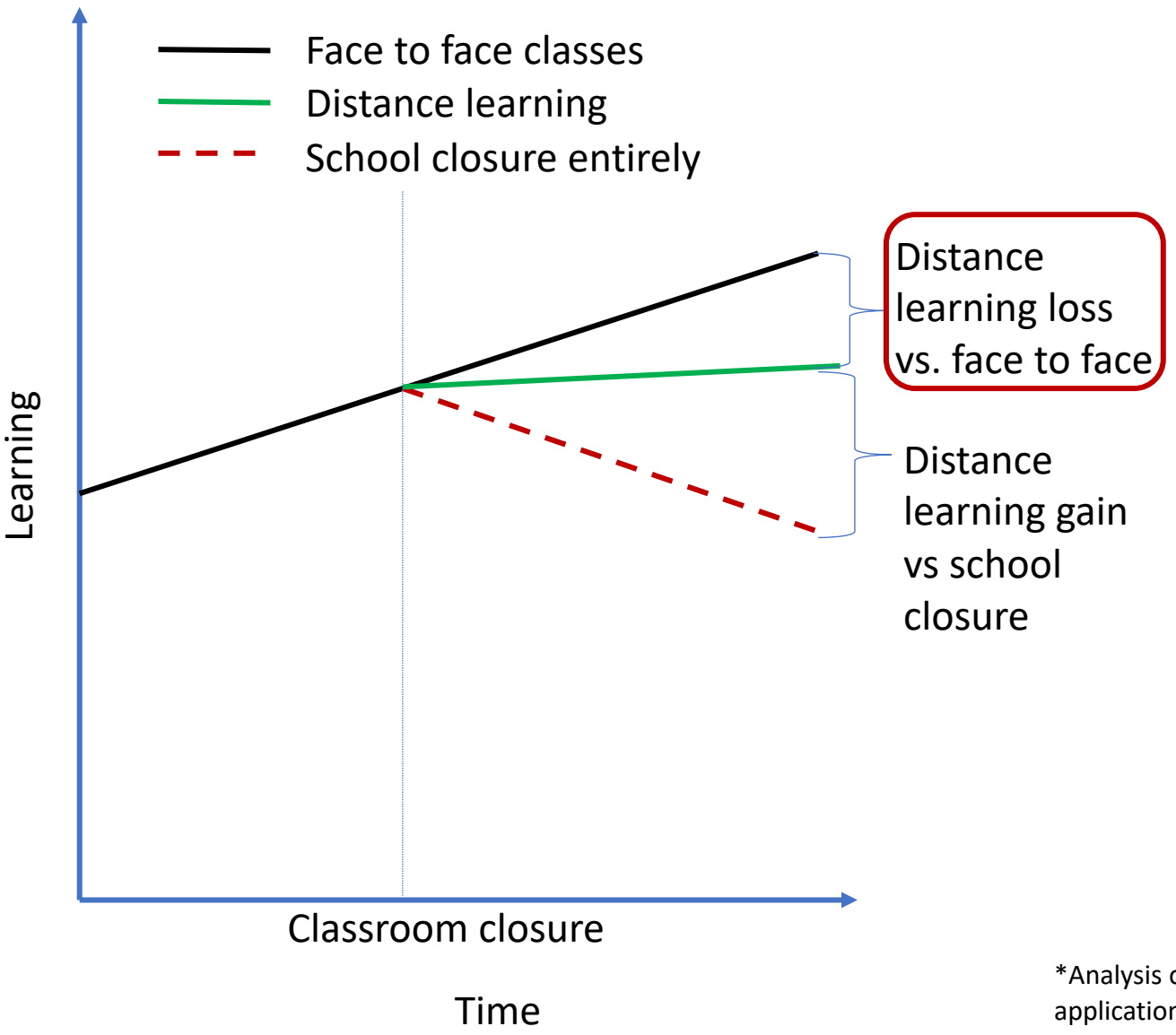
Source: Kuhfeld and Terasawa 2020.

- Studies of the "summer slide" find that students lose learning during school breaks at the same rate as they gain learning during the year

  - Full closure of schools during 1 school year would cause students to lose 2 years of learning!

See Kuhfeld 2019; Alexander et al. 2016; and Borman et al. 2009 for more details.

Learning under distance education



- Assume distance learning always able to fully offset potential learning losses when schools closed
- Assumption that 60% of additional learning occurs in best situation
- Reduce if parents have lower education, both are working, there is no internet, and multiple children need to be taught.*
- Weighted average across ages is that there is 22% learning gain of a normal classroom situation (78% less learning)

*Analysis of numbers of children in each grade by household status using FIES 2015 microdata, and application of modifiers based on conditions.

Distance learning costing

- Captures the loss of education during community quarantine and possible closures thereafter
- Returns to education identified using a standard Mincer earnings regression
  - LFS 2018 data
  - Heckman correction for self-selection into labor force
  - Controls for experience
- Fraction of school year lost used with estimated coefficients, school cohort model to calculate present value of wages lost during future labor market participation in the next 40 years with 3% discounting

	(1)
	lnwage
years of schooling	**0.102*** **
	(0.001)
Experience	0.018***
	(0.000)
experience squared	-0.000***
	(0.000)
_cons	5.142***
	(0.010)
select: experience	-0.010***
	(0.000)
select:_cons	-0.466***
	(0.011)
athrho:_cons	-1.022***
	(0.011)
lnsigma:_cons	-0.376***
	(0.005)
chi2	27687.508
p	0.000
rho	-0.771
sigma	0.686
lambda	-0.529
chi2_c	8960.346
p_c	0.000
married	yes
male	yes
pufhhsize	yes

Source: Authors' estimates.

Education affects health – effects via smoking

Regression results from FIES 2015	-1	-2
	With Tobacco Expenditure	With Tobacco Expenditure
VARIABLES	OLS	Logit dydx
educ_hh	-0.027***	-0.026***
	(0.001)	(0.001)
female_share	-0.345***	-0.345***
	(0.011)	(0.011)
Total Income	-0.000***	-0.000***
	(0)	(0)
Hhsize	0.033***	0.034***
	(0.001)	(0.001)
mem_atleast15_agemean	-0.003***	-0.003***
	(0)	(0)
urban	-0.004	-0.003
	(0.006)	(0.006)
Region fixed effects	Yes	Yes
Observations	41,391	41,391
R-squared	0.101	

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' estimates.

- 2.7 percentage point reduction in household tobacco per year of average education of adults
  - 1.24 percentage point reduction in individual smoking rate per year of education
- Translates into
  - Via loss of education in 2020/2021 school year only, 51,200 additional premature future deaths
  - Via 5% enrollment decline plus above, 70,200 deaths

Education affects health – effects via child mortality

Fractional logit regressions	(1)
VARIABLES	Share of deceased children
mother_yrs_schooling	-0.066***
	(0.016)
mother_age	0.015*
	(0.008)
total_income	-0.000**
	(0.000)
urban	0.087
	(0.137)
Constant	-4.229***
	(0.428)
Regional fixed effects	Yes
Observations	10,938

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Source: Authors' estimates.

- Implies a 0.14% decline in probability of child death per year of mother's education
- Translates into
  - Via loss of education in 2020/2021 school year only, 28,000 additional premature future deaths
  - Via 5% enrollment decline plus above, 38,700 deaths
- Total of 79,200 – 108,900 additional deaths from classroom closure, vs 200 – 5,200 lives saved