LEARNING AND EARNING LOSSES FROM COVID-19 SCHOOL CLOSURES IN DEVELOPING ASIA

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Learning and earning losses from COVID-19 school closures in developing Asia

COVID-19 led to prolonged school closures to varying degrees across developing Asia. These disruptions will affect the skills students acquire and eventually their productivity as future workers. Various distance learning strategies are being used, but they are only partially effective. Thus, school closures come at the price of learning. Learning losses range from 8% of a learning-adjusted year of schooling in the Pacific, where schools have mostly stayed open, to 55% in South Asia, where school closures have been longest. Learning losses will reduce the future productivity and lifetime earnings of affected students. The present value of these losses is estimated at $1.25 trillion for developing Asia, equivalent to 5.4% of the region's 2020 gross domestic product (GDP).

Schools closed due to COVID-19

The COVID-19 pandemic led many countries to close schools, in part or in full to help contain the virus. By April 2021, schools had been closed for about 1 year or more in eight of 46 economies in developing Asia. In 11 other economies in the region, schools had been closed for 200–300 days (Figure 1.2.1). Full school closures have been longest in Bangladesh and Myanmar; both countries have had over 300 days of government-mandated closures. In the Philippines, all schools have been closed for more than 200 days. Most economies in developing Asia implemented partial closures, such as closing schools only in certain regions or for some grade levels and age groups. In some instances, schools have combined reduced class time with distance learning (UNESCO 2021). Only three economies in developing Asia had not closed schools by April 2021, and in most Pacific economies, schools have been closed for 50 days or less.

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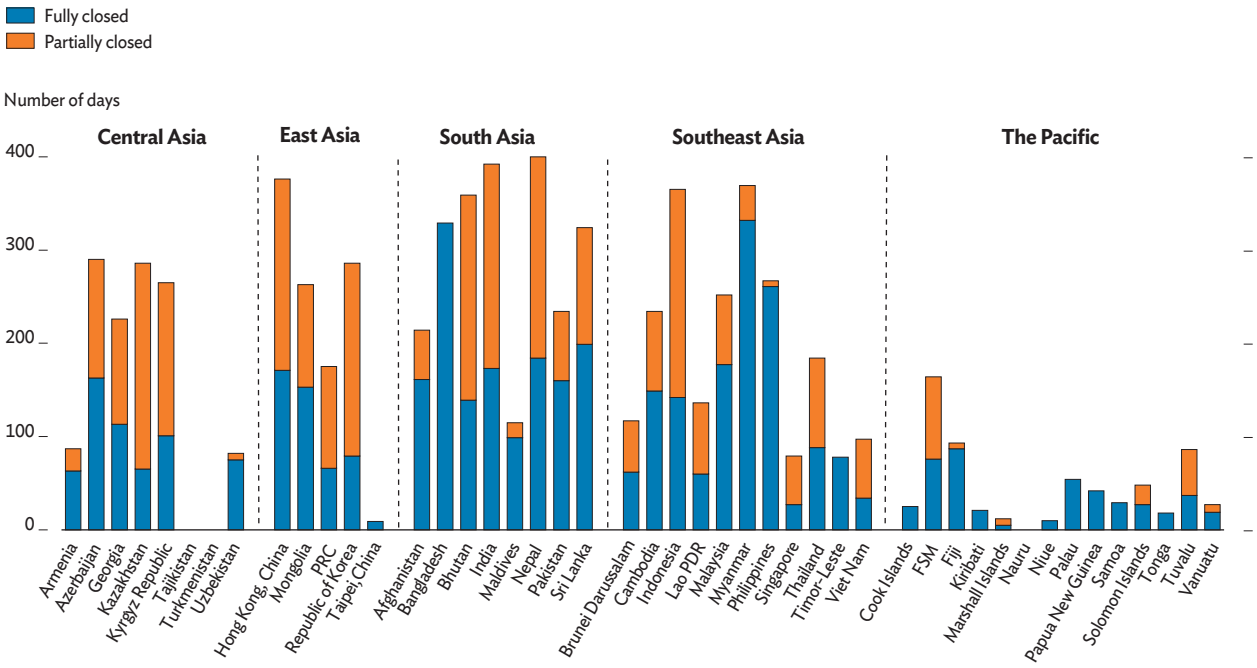
Figure 1.2.1 Number of days schools partially or fully closed, February 2020 to April 2021



FSM = Federated States of Micronesia, Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China.

Sources: UNESCO COVID-19 Response. https://en.unesco.org/covid19/educationresponse (accessed 30 March 2021); for Hong Kong, China and Taipei,China, Oxford COVID-19 Government Response Tracker. www.bsg.ox.ac.uk/covidtracker (accessed 14 April 2021).

School closures mean students lose opportunities to learn vital cognitive, social, physical, and emotional skills. Students also tend to forget part of what they have learned when they take a break from school (Cooper et al. 1996). From a life-cycle perspective, the skills that children learn at a younger age set the stage for acquiring more advanced skills as they get older. When young students miss out on opportunities to learn these skills, the total skill level that they acquire in their lifetime is at risk of being lower (Meyers and Thomasson 2017; Gibbs et al. 2019; Andrabi, Daniels, and Das 2020). For this reason, this analysis focuses on students at the preprimary, primary, and secondary levels of education.

Remote learning strategies used

Economies all over the world have used alternative learning options to make up for lost school days. A UNESCO, UNICEF, and World Bank survey of education ministry officials conducted from April to October 2020 shows that online and television platforms have been the predominant modes of instruction in economies in developing Asia during the COVID-19 pandemic (Table 1.2.1). Online platforms include government websites that provide learning content and video

Table 1.2.1 Remote learning modes

Subregion	Economy	Survey month	Online platforms	Television	Radio	Take-home packages
Central Asia	Armenia	August	■	■	■	■
	Azerbaijan	September	■	■		
	Georgia	August	■	■		
	Kazakhstan	April, May, or June	■	■	■	
	Kyrgyz Republic	September	■	■	■	■
	Uzbekistan	August	■	■	■	
East Asia	Hong Kong, China	September	■			■
	Mongolia	July	■	■		
	PRC	September	■	■	■	■
	Republic of Korea	October	■	■		■
South Asia	Afghanistan	August	■	■	■	
	Bangladesh	April, May, or June		■	■	
	Bhutan	August	■	■	■	
	India	April, May, or June	■	■	■	■
	Maldives	August	■	■		
	Nepal	August	■	■	■	■
	Pakistan	October	■	■	■	■
	Sri Lanka	August	■	■	■	■
Southeast Asia	Cambodia	September	■	■		■
	Indonesia	April, May, or June	■	■		■
	Lao PDR	July	■	■	■	■
	Malaysia	April, May, or June	■	■		■
	Myanmar	April, May, or June	■	■	■	■
	Philippines	April, May, or June	■	■	■	■
	Singapore	August	■			■
	Thailand	July	■	■		■
	Timor-Leste	April, May, or June	■	■	■	■
	Viet Nam	July	■	■		■
The Pacific	Cook Islands	July	■			■
	Fiji	April, May, or June	■	■	■	■
	Kiribati	April, May, or June	■			
	Niue	April, May, or June				■
	Palau	April, May, or June	■			■
	Papua New Guinea	April, May, or June	■	■	■	
	Samoa	October	■	■	■	
	Solomon Islands	August	■	■	■	■
	Tonga	July	■	■	■	■
	Tuvalu	August	■	■	■	■
	Vanuatu	August	■	■	■	■

Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China.

Sources: UNESCO, UNICEF, and World Bank. 2020. Survey on National Education Responses to COVID-19 School Closures, Round 1 (April–June) and Round 2 (July–October). http://tcg.uis.unesco.org/survey-education-covid-school-closures/ (accessed 13 April 2021).

conferencing platforms, such as Zoom and Google Meet. Some video lessons are also delivered via YouTube. Social media facilitates communication. Educational television programs are being made by both governments and the private sector. Another common practice is to distribute paper-based learning modules and worksheets as a complement or substitute for students who have no access to television or the internet.

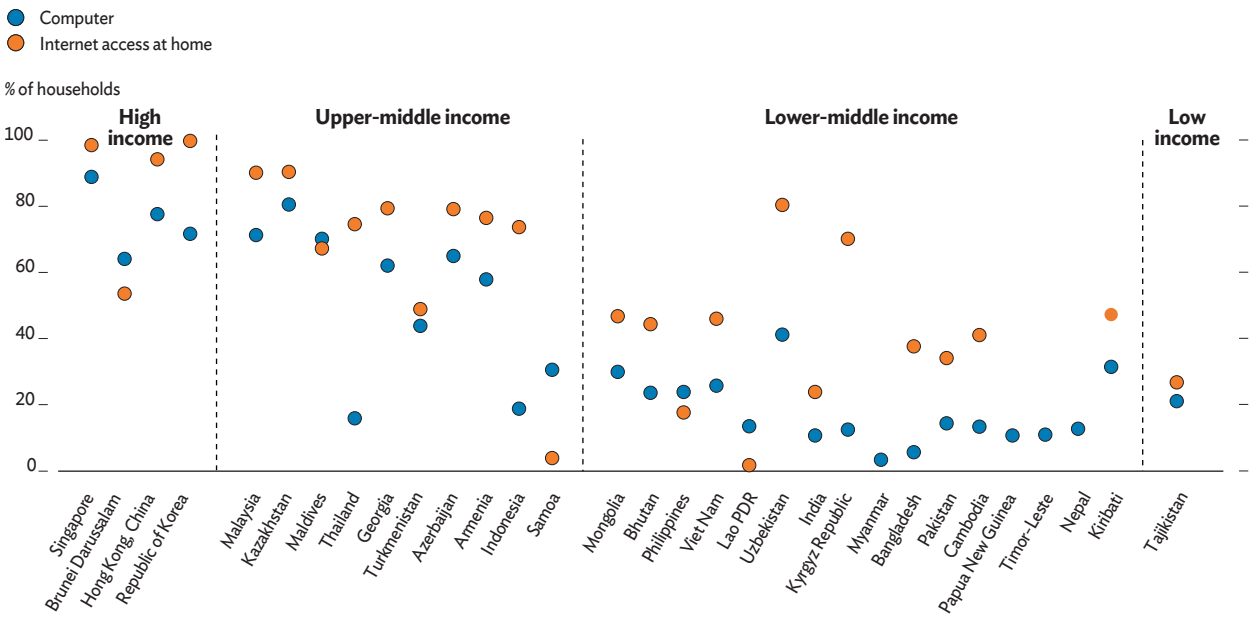
The day-to-day operations of distance learning are largely the responsibility of teachers and parents or caregivers, who do the teaching and monitor progress. The sudden closure of schools because of the COVID-19 pandemic left teachers and parents with little time to prepare for home schooling. Teachers in the economies of developing Asia were provided support in the form of special training, instructions on remote learning, and, in some cases, information and communication technology tools and free connectivity (UNESCO, UNICEF, and World Bank 2020a). Parents or caregivers face the challenge of supervising their children's distance learning in addition to other responsibilities, such as housework and work-from-home. Parents or caregivers were given guidance materials for home-based learning to support their new role (UNESCO, UNICEF, and World Bank 2020a).

It is too early to gauge the effectiveness of the distance learning strategies adopted during the COVID-19 pandemic. But the task of remotely delivering mass education has not only been enormous but also had to be done practically at a moment's notice. Three reasons point to why remote learning strategies taken during the COVID-19 pandemic could be less effective than prepandemic distance learning—their unplanned nature, the involvement of younger-age children, and distractions at home that keep children from being able to focus on studying. As Toquero (2021) puts it, the strategies deployed in response to sudden school closures were "emergency remote education."

Evidence from France and Italy show that parents see their children making slower progress using distance learning during pandemic-induced lockdowns than when they were in school (Champeaux et al. 2020). Online learners in developing countries have been found to score lower in tests than learners in developed countries, and they have far higher attrition rates (Kizilcec and Halawa 2015). Because of this, learning outcomes are likely to have been lower and attrition rates higher among distance learners in developing countries during the pandemic.

Access to remote education will of course depend on households having the necessary equipment. Computer ownership and internet access at home varies considerably across developing Asia (Figure 1.2.2). While 76% of households in high-income economies have computers and 86% internet access, average access to computers and the internet in upper-middle-income economies is only 52% and 68%, respectively.

Figure 1.2.2 Share of households with computer and internet access at home



Lao PDR = Lao People's Democratic Republic.

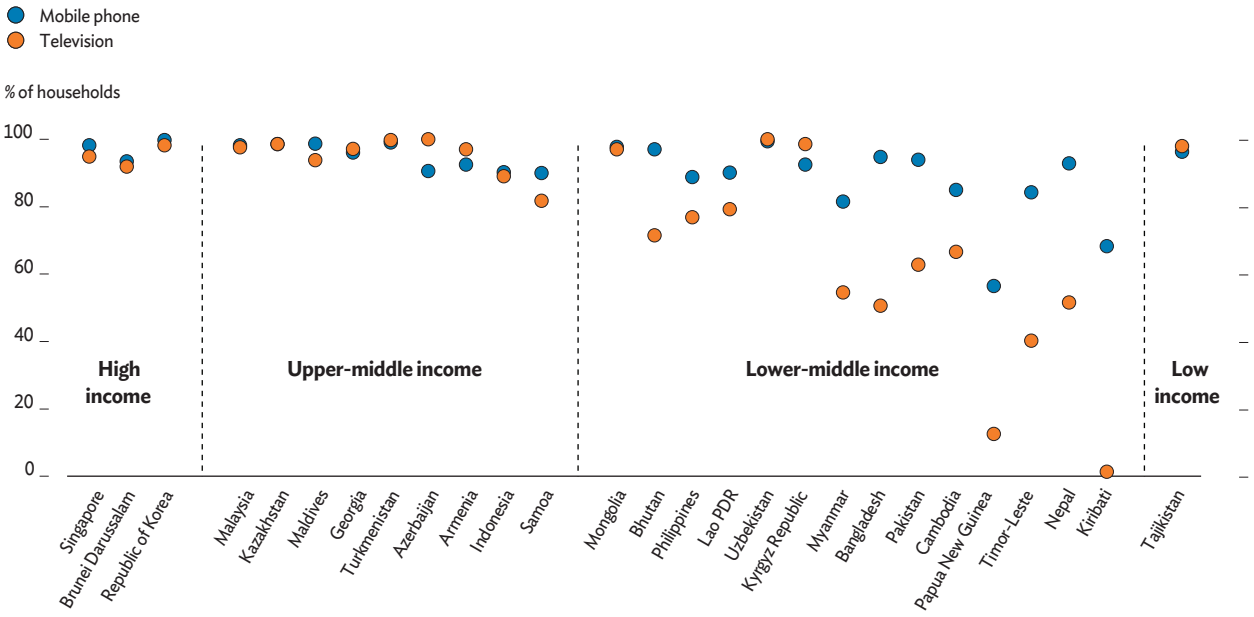
Note: Economies within each income group are arranged by 2019 gross domestic product per capita, highest to lowest. Data on access to computers and the internet are for 2019 except Bhutan (2017), India (2018), Kiribati (2018), the Lao PDR (2017), Maldives (2016), Myanmar (2017), Nepal (2016), Papua New Guinea (2016), Samoa (2016), Tajikistan (2017), Timor-Leste (2016). In Uzbekistan and Viet Nam, data on computer access are from 2019 and data on internet access from 2018.

Source: International Telecommunication Union. World Telecommunication/ICT Indicators Database. https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx (accessed 06 April 2021).

In lower-middle income economies, only 18% of households on average have a computer and 41% have internet access at home.

Mobile phones and television are available in most households in developing Asia, albeit less so in lower-income economies (Figure 1.2.3). Because of this and the relatively low computer ownership, online learning is likely being mainly done by mobile phone. Ministries of education in 15 economies in developing Asia have implemented programs to make remote education accessible through mobile phones. In 11 economies, education authorities distributed subsidized or free devices to access online education. Governments in 17 economies in developing Asia negotiated with internet providers to grant connectivity at subsidized or zero cost for the purpose of accessing education materials (UNESCO, UNICEF, and World Bank 2020a).

Figure 1.2.3 Share of households with mobile phone and television



Lao PDR = Lao People's Democratic Republic.

Note: Economies within each income group are arranged by 2019 gross domestic product per capita, highest to lowest. Data on access to mobile phones and television are for 2019 for Armenia, Azerbaijan, Bangladesh, Kazakhstan, the Kyrgyz Republic, Malaysia, Mongolia, the Republic of Korea, and Turkmenistan; 2018 for Brunei Darussalam, Georgia, Kiribati, Thailand, and Uzbekistan; 2017 for Bhutan, Cambodia, Indonesia, the Lao PDR, Myanmar, Pakistan, the Philippines, Singapore, and Tajikistan; and 2016 for Maldives, Nepal, Papua New Guinea, Samoa, and Timor-Leste.

Sources: International Telecommunication Union. World Telecommunication/ICT Indicators Database. https://www.itu.int/en/ITU-D/Statistics/Pages/stat/default.aspx (accessed 6 April 2021). For television access in Indonesia, Multiple Indicator Cluster Survey and Demographic and Health Survey data. https://public.tableau.com/profile/unicefdata#!/vizhome/EduViewv1_0/home (accessed 03 March 2021).

Learning losses

A lost year of schooling comes at the price of learning. So, how much do students learn in 1 year of going to school? The Organisation for Economic Co-operation and Development estimated an average gain of 40 percentage points in the Programme for International Student Assessment (PISA) test. This is a lower-bound estimate because it captures only the learning aspects measured by PISA tests—cognitive aspects—and not the noncognitive aspects like social and emotional skills. At the very least, students lose this learning gain with every year of school closure.

Remote learning can mitigate these losses, but the success of this strategy depends on access to learning materials and the effectiveness of these materials. Evidence on both in developed economies and limited access to these materials in developing Asia suggest that remote learning during the COVID-19 pandemic has been less effective than classes at school. Because there are currently no precise estimates on the effectiveness of remote learning during the pandemic, three effectiveness scenarios are considered—optimistic, intermediate, and pessimistic—by country income group (high,

Table 1.2.2 Effectiveness of remote learning relative to classroom learning in developing Asian economies, %

Scenario	High income economies	Upper-middle income economies	Lower-middle income economies	Low income economies
Optimistic	88	67	38	17
Intermediate	66	50	29	13
Pessimistic	37	28	16	7

Source: Asian Development Bank estimates.

upper-middle, lower-middle, low). The assumptions in these scenarios are based on literature estimates of online-learning effectiveness (Paul and Jefferson 2019; McKinsey & Company 2020), internet access, access to television, the effectiveness of television relative to online learning, and the relative shares of students undergoing online and television-based learning (Technical Appendix A1). Table 1.2.2 summarizes the assumptions on the effectiveness of remote learning for different income groups and effectiveness scenarios.

The COVID-19 pandemic has also had an indirect effect on learning through income shocks. The economic contraction in 2020 led to higher unemployment and lower incomes, forcing more people into poverty. The Asian Development Bank estimates that because of COVID-19, 162 million more people in developing Asia are living below the $3.20 a day poverty threshold (ADB 2020; Martinez, Sebastian, and Bulan 2020). Against this backdrop, an increasing number of households have been unable to continue supporting their children's education—and because of this, more children have dropped out of school during the pandemic, which is lowering the average learning achievement of affected countries. An estimated 506,130 more students out of 800 million preprimary, primary, and secondary school students in developing Asia dropped out of school during the pandemic in 2020. The increase in the dropout rate is computed by applying the decline in 2020 GDP per capita to the income elasticity of dropout rates (Technical Appendix A1). The change in the dropout rate is then multiplied by the number of students to estimate the rise in out-of-school youth.[1]

[1] This may be an underestimate for two reasons. First, it considers the effect of falling household incomes only and does not capture students who drop out of school for other reasons, such as taking care of elderly family members, household work, lack of adult supervision on remote learning, helping augment household incomes, or being the victims of domestic abuse (UNESCO 2020). Second, it uses the decline in average GDP per capita notwithstanding that unemployment and wage losses have been larger for lower-income workers, many of whom work in contact-intensive services and industry jobs and have no recourse to work-from-home.

Learning losses can be measured in terms of learning-adjusted years of schooling (LAYS), which capture both the quantity and quality of education. LAYS are measured as the number of years of schooling a child can expect to obtain by age 18, adjusted by a country's average student achievement. This is measured using standardized test scores that are harmonized across countries (Patrinos and Angrist 2018). Figure 1.2.4 shows how LAYS adjust the average years of schooling to account for the quality of learning.

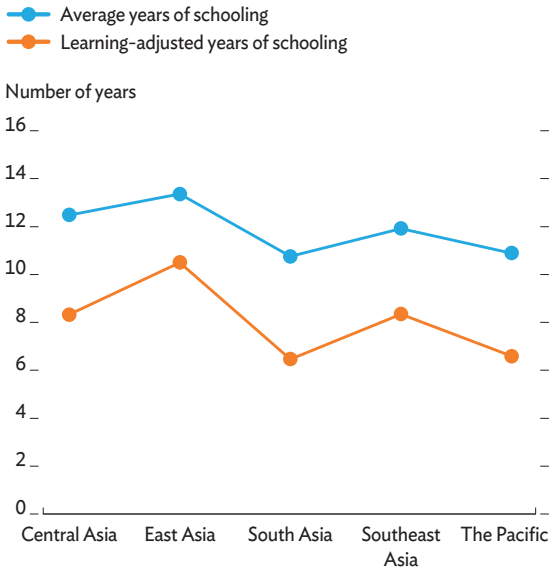
LAYS apply to preprimary, primary, and secondary education. Tertiary students are excluded in this analysis of learning losses for three reasons. First, they have, in principle, already acquired the basic skills taught at the lower levels. Second, because they are more heterogeneous in terms of age and degree programs, using averages may not be a good representation of this group. And third, some tertiary students were already working while studying so they may have lost current income on top of future earning losses. UNESCO (2020) estimates that tertiary students are more likely to drop out of school during the pandemic than students in other education levels. So, because tertiary students are excluded in this analysis, the learning and earning losses are likely to be underestimated.

The framework of Azevedo et al. (2021) is used to measure the losses in learning and potential earnings of students affected by COVID-19 school closures (Technical Appendix A1). This framework assumes that school closures affect LAYS through its two components—the expected years of schooling (quantity effect) and harmonized test scores (quality effect). Both effects are mitigated by the effectiveness of remote learning. The indirect effect of income shocks also reduces the expected years of schooling.

In 2020, developing Asia had an average of 7.72 LAYS based on the World Bank's Human Capital Index. Because of school closures during the COVID-19 pandemic, students in the region lost an estimated 29% of a learning-adjusted year of schooling in the intermediate scenario for the effectiveness of remote learning (Table 1.2.3). In the best-case scenario, they lost about 23% of a learning-adjusted year of schooling and in the worst case, 38%.

Learning losses vary by subregion. In South Asia, where school closures have been longest, the loss in learning is equivalent to 0.55 LAYS or 8.6% of 2020's baseline LAYS. In the Pacific, however, only 0.08 of a learning-adjusted year of schooling (1.3% of the baseline) was lost (Table 1.2.3). Here, schools have mostly stayed open during the COVID-19 pandemic. Estimates by economy show that learning losses vary with the length of school closures (Figure 1.2.5).

Figure 1.2.4 Average and learning-adjusted years of schooling, 2020



Source: World Bank. Human Capital Index. https://datacatalog.worldbank.org/dataset/human-capital-index (accessed 11 February 2021).

Table 1.2.3 Average learning losses

	Average loss in LAYS			% decline in LAYS			Baseline
Subregion	Optimistic	Intermediate	Pessimistic	Optimistic	Intermediate	Pessimistic	LAYS 2020
Central Asia	0.19	0.24	0.32	2.24	2.93	3.86	8.32
East Asia	0.23	0.39	0.59	2.18	3.67	5.64	10.50
South Asia	0.49	0.55	0.65	7.56	8.56	9.99	6.46
Southeast Asia	0.27	0.35	0.45	3.26	4.20	5.45	8.34
The Pacific	0.06	0.08	0.11	0.97	1.28	1.70	6.59
Developing Asia	**0.23**	**0.29**	**0.38**	**2.96**	**3.78**	**4.88**	**7.72**

LAYS = learning-adjusted years of schooling.

Note: These estimates do not include the following economies because data are not available for at least one estimation parameter: the Cook Islands; Maldives; Niue; and Taipei,China.

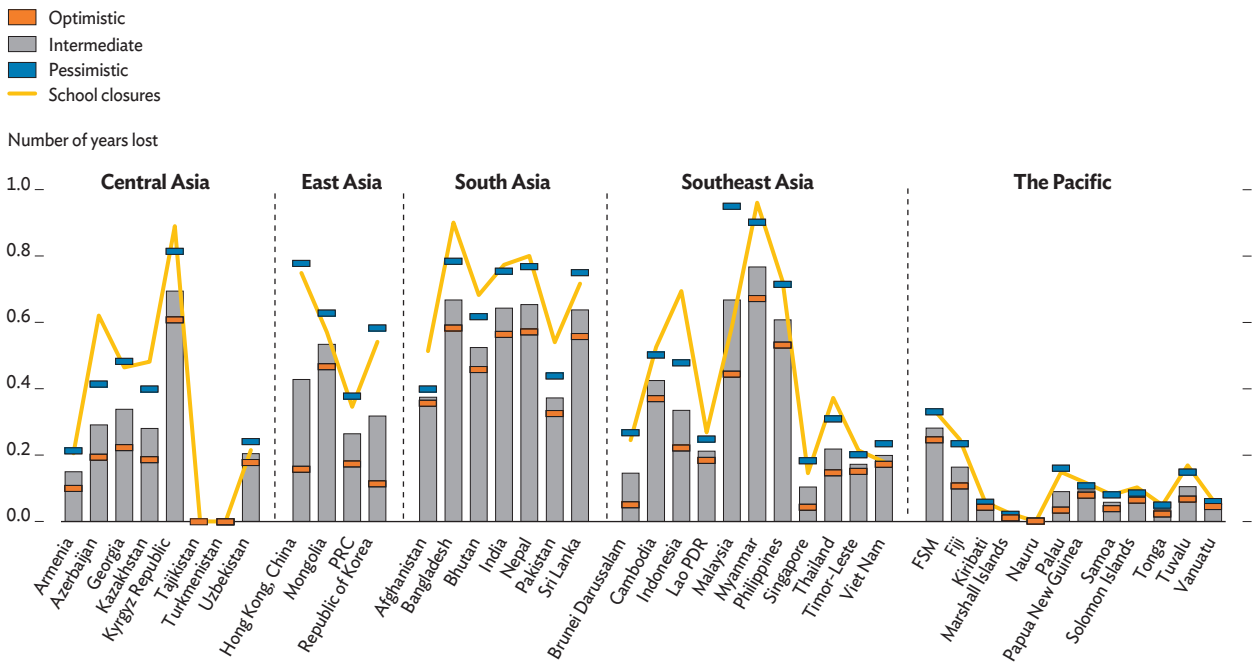
Sources: World Bank. Human Capital Index for 2020 LAYS; Asian Development Bank estimates.

Each day of a partial school closure in this analysis is assumed to be equivalent to half a day of full closure. This is only a rough approximation because the form and extent of partial closures vary across economies and over time. Even within economies, partial closures vary across locations and grade levels. School closures during the COVID-19 pandemic have been intensified or relaxed depending on changes in the status of community transmission. Anecdotal evidence from media reports and government advisories (Australian Government 2020; Inquirer Net 2021; Chopra 2021; Yoon 2020; Dagur 2021) provide the basis for setting the weight of partial school closures at 0.50 of a full closure. Allowing for the possibility that the actual degree of closures can be greater than or less than 0.50, Technical Appendix A2 gives a sensitivity analysis with alternative weights of partial school closures.

Losses in potential earnings

It is well-established that a person's earnings increase with more years of schooling. On average, every additional year of schooling increases a person's annual earnings by 9.7% (Montenegro and Patrinos 2014). Thus, every year of schooling lost is equivalent to 9.7% less in potential earnings. This is the average rate of return to every learning-unadjusted year of schooling, and if this rate is applied to LAYS, it likely underestimates the returns to each quality-adjusted year of schooling. Because LAYS are a new concept—they came out in 2018—no study has yet measured the average returns to every learning-adjusted year of schooling. This analysis takes the economy-specific returns to every year of schooling based on the latest literature (Montenegro and Patrinos 2014; Psacharopoulos and Patrinos 2018), distinguishing the returns

Figure 1.2.5 Losses in learning-adjusted years of schooling



FSM = Federated States of Micronesia, Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China.

Note: School closures are the number of days that schools are partially or fully closed, normalized by 365 days. Each day of partial closure is assumed to be equivalent to half a day of full closure.

Source: Asian Development Bank estimates.

between primary and secondary education where data are available, and then computing the loss in potential earnings that can arise from learning losses incurred during the COVID-19 pandemic.

On average, every student affected by school closures in developing Asia stands to lose an estimated $180 every year, equivalent to a 2.4% drop in average annual earnings.[2] In dollar terms, potential earning losses per student are highest in East Asia ($771), where average earnings before the COVID-19 pandemic were also highest. The percentage decline is highest in East Asia (4.0%) and in South Asia (4.0%), where school closures have been longest (Table 1.2.4).

[2] These estimates make a simple assumption—that in the absence of COVID-19 school closures, future workers would be earning the same as present-day workers. Actual wage dynamics depend on many factors affecting both the demand and supply sides of the labor market. During the pandemic, these factors have been moving in different directions and in different locations. Whether this assumption leads to an overestimate or underestimate of earnings cannot as yet be stated. Time will tell how actual earnings develop, both for students affected by school closures and those who were not.

Table 1.2.4 Potential earning losses per student

	Losses in earnings per student per year, current $			% decline in earnings per student per year			Baseline average earnings per worker per year, current $
Subregion	Optimistic	Intermediate	Pessimistic	Optimistic	Intermediate	Pessimistic	
Central Asia	39	56	78	1.1	1.6	2.2	3,552
East Asia	332	771	1,344	1.7	4.0	7.0	19,182
South Asia	68	78	92	3.5	4.0	4.7	1,948
Southeast Asia	105	167	247	1.2	1.9	2.9	8,663
The Pacific	30	42	58	0.5	0.6	0.9	6,509
Developing Asia	**99**	**180**	**286**	**1.3**	**2.4**	**3.8**	**7,637**

Notes: These estimates do not include the following economies because data are not available for at least one parameter: Afghanistan; Bhutan; the Cook Islands; Kiribati; Maldives; the Marshall Islands; the Federated States of Micronesia; Niue; Palau; Papua New Guinea; Solomon Islands; Taipei,China; Tonga; and Tuvalu. Because data on baseline earnings are not available for Tajikistan and Turkmenistan, they are not included in the baseline average for Central Asia.

Sources: ILOSTAT for baseline average earnings per worker; Asian Development Bank estimates.

These losses are aggregated by applying the earning losses to all students affected by school closures. To account for the possibility that not all students will be in gainful employment later, the aggregate losses are adjusted by the expected adult survival rate and human capital utilization rate, both from the World Bank's Human Capital Index. The present value of total losses is calculated to reach $1.25 trillion for developing Asia.[3] This is equivalent to 5.4% of the region's GDP in 2020. In the optimistic scenario for the effectiveness of remote learning, total losses are equivalent to $0.8 trillion (3.6% of 2020 GDP) and $1.8 trillion (7.6% of GDP) in the pessimistic scenario (Table 1.2.5). Technical Appendix A3 gives the estimates of learning and earning losses by economy and subregion.

These losses in potential earnings cover only private returns to education—they do not capture the full social returns nor the long-term benefits of education on health. Society at large tends to benefit from each person's education on top of a person's own gains in productivity and earnings. If the full social returns to education are considered, then the value of lost learning will likely be even higher.

The long-term effects of school closures on learning and earnings have been documented in previous settings, including World War II (Ichino and Winter-Ebmer 2004) and the Chinese Cultural Revolution of 1966–1977 (Meng and Gregory 2000). It will be many years from now before the precise effects of COVID-19 school closures on the actual earnings of today's students will be fully observed. But current students can benefit from policy interventions that help abate their potential losses.

[3] Assumed is a discount rate of 3%, a working life of 45 years, and current students enter the work force 10 years from now on average.

Table 1.2.5 Aggregate earning losses

Subregion	Losses in lifetime earnings, current $ million			Losses in lifetime earnings, % of 2020 GDP		
	Optimistic	Intermediate	Pessimistic	Optimistic	Intermediate	Pessimistic
Central Asia	8,127	11,361	15,572	2.2	3.1	4.2
East Asia	551,989	896,251	1,340,785	3.3	5.4	8.1
South Asia	171,866	195,787	230,083	5.1	5.9	6.9
Southeast Asia	109,454	147,503	197,366	3.6	4.9	6.5
The Pacific	169	247	349	2.5	3.7	5.2
Developing Asia	**841,604**	**1,251,149**	**1,784,155**	**3.6**	**5.4**	**7.6**

GDP = gross domestic product.

Note: These estimates do not include the following economies because data are not available for at least one parameter: Afghanistan; Bhutan; the Cook Islands; Kiribati; Maldives; the Marshall Islands; the Federated States of Micronesia; Niue; Palau; Papua New Guinea; Solomon Islands; Taipei,China; Tonga; and Tuvalu.
Source: Asian Development Bank estimates.

Policies to minimize learning and earning losses

Adequate policy responses can mitigate the potential damage to lost learning and earnings, and ensure that postpandemic education systems are better than they were before. The policy priority must be to bring COVID-19 under control so that all students can safely return to in-person instruction. The decision to reopen should be evidence-based, context-specific, and account for both earnings and health losses in weighing costs against benefits (Raitzer et al. 2020).

Where school closures remain necessary and education continues to rely on remote learning, government and supporting stakeholders should take the following actions to mitigate learning losses:

(i) Create a structured learning plan and set clear directions and realistic expectations. It will not be possible to cover the same curriculum as in normal times, and there should be no expectations to do this. Although it might be tempting to focus scarce resources on all numeracy and literacy skills, a distance-learning curriculum that gets students to think deeply about core topics in science, the humanities, civics, and so on is likely to boost student engagement, while also building language and analytical skills.

(ii) Continue strengthening information and communication technology infrastructure. Heavy connectivity use during the COVID-19 pandemic has tested the limits of these networks in several countries.

(iii) Continue to use diverse modalities to provide accessible learning experiences for students in remote areas. Where online learning is not possible, these modalities can include television, radio courses, and paper-based learning.

(iv) Continue to provide devices for children from disadvantaged backgrounds and more affordable devices for all families, especially those with more than one child.

(v) Provide systematic training on digital literacy for students and parents, and effective remote pedagogy for teachers.

(vi) Develop and maintain a feedback loop between developers and administrators of remote learning platforms and end users to improve the quality and effectiveness of remote learning systems.

(vii) Encourage social interaction between students, teachers, and parents within the remote learning environment.

(viii) Develop more inclusive tools to make digital learning resources accessible to people with disabilities.

The end to the global COVID-19 pandemic will take a while. Given the high level of uncertainty over containing the pandemic, comprehensive plans must be developed for remote learning that have contingencies for full-time remote learning and hybrid approaches.

Where COVID-19 outbreaks are sufficiently contained, reopening schools should be considered on the basis of local health conditions and school-specific information. These include local transmission and vaccination rates, size of the student body, ability to divide students into smaller cohorts, and the physical condition of school buildings (Bi et al. 2020). School reopenings should prioritize preprimary and primary education since the returns to early childhood education are the highest (Knudsen et al. 2006). The following precautions will help maintain safety within school premises and lower the risk of incurring additional learning losses from school reclosures:

(i) Convert additional space into larger classrooms to enable physical distancing by students and teachers.

(ii) If facilities cannot be expanded, use staggered daily calendars to prevent crowding.

(iii) Group students together in protective bubbles—that is, small groups that stay together throughout the school day. This will involve staggering lunch and break times in and outside the classroom so that bubbles do not mix.

(iv) Build WASH—water, sanitation, and hygiene—facilities; encourage behavior change, mask wearing, and hand washing; and install hand sanitizer dispensers.

(v) Open lines of communication between school administrators and families to track COVID-19 cases and put classes on hold when necessary.

When reopening, schools need to conduct “simple, fast, cheap, and low-stakes” diagnostic tools to “meet children where they are and start teaching from there” (Teaching at the Right Level 2021). Learning gaps can be recouped through remedial education programs that have proven effective in

some contexts (Banerjee et al. 2007). School curricula must evolve to pick up where students have left off and adjustments must be made based on the results of regular tracking of student progress (Duflo, Dupas, and Kremer 2011).

The COVID-19 pandemic is an opportunity to reimagine and rebuild education systems. Multimedia tools tapped during the pandemic can be integrated into regular education systems, taking advantage of high mobile phone penetration, for instance, to maximize reach. Teachers must be equipped to use multimedia effectively by enhancing their digital skills (Panth and Xu 2021), building their capacity for more effective pedagogy, providing lifeline support to help solve any technological question they may have, facilitating peer-to-peer learning, and setting healthy boundaries to help them avoid burnout (Barron et al. 2021).

This is an opportune time to transform the way countries deliver education and strive to meet Sustainable Development Goal 4—to ensure inclusive and equitable quality education for all by 2030. School curricula are ripe for transformation. This is also the time to harness the momentum of parents' involvement with their children's education—they can, for example, take part in simple educational activities with their children at home and become more involved in exchanging information on their children's learning. The importance of digital infrastructure and connectivity is underscored by the remote learning phase. Investing in this will pay dividends long after the COVID-19 pandemic ends.

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Technical Appendix

A1 Estimating learning losses

The framework of Azevedo et al. (2021) is used to calculate the losses in learning-adjusted years of schooling (LAYS) associated with school closures. Learning losses occur via the two components of LAYS: the expected years of schooling (EYS) and harmonized test scores (HTS), where

$$LAYS = EYS \times HTS.$$

The length of school closures reduces a country's average EYS (quantity effect). Its effect on EYS is mitigated by the effectiveness of remote learning strategies for students who remain in the education system. Students who drop out of school because of income shocks during the COVID-19 pandemic bring down a country's average EYS. The change in EYS is thus:

$$\Delta EYS = -s_c \times (1-m_c) \times (1-\Delta d_c) - (\Delta d_c \times EYS_o),$$

where s_c is the length of school closures in country c, m_c is the effectiveness of remote learning, Δd_c is the change in the dropout rate in country c, and EYS_0 is the baseline value of EYS.

The effectiveness of remote learning is based on assumptions by scenario and country income group (Table 1.2.2). These assumptions are calibrated as follows:

First, effectiveness of remote learning in the high-income country group (HIC) is given by online-learning effectiveness multiplied by average internet penetration in the HIC. The optimistic scenario for online-learning effectiveness is based on Paul and Jefferson (2019), who found no significant difference in student performance between online and face-to-face teaching for a sample of students in the United States. Intermediate and pessimistic scenarios are based on McKinsey & Company (2020), which estimates that distance learning over a 12-month period causes a learning penalty of 3 months if students receive remote instruction of average quality and 7 months if remote instruction is of lower quality. The intermediate scenario takes the 3-month learning penalty—equivalent to 75% effectiveness—and the pessimistic scenario takes the 7-month penalty—equivalent to 42% effectiveness.

Second, effectiveness of remote learning in upper-middle (UMIC), lower-middle (LMIC), and low-income (LIC) country groups is equal to the remote-learning effectiveness in the HIC multiplied by an adjustment factor. This adjustment factor, F_k, for country group $k \in \{UMIC, LMIC, LIC\}$, is computed as

$$F_k = w \times \frac{IP_k}{IP_{HIC}} + (1-w) \times \frac{TVP_k}{TVP_{HIC}} \times \frac{TVE_k}{OLE_k},$$

where w is the weight of online learning relative to the television (TV) mode of instruction, IP_k and IP_{HIC} are average internet penetration in country group k and the *HIC*, respectively, TVP_k and TVP_{HIC} are average TV penetration in country group k and the *HIC*, respectively, and TVE_k and OLE_k are effectiveness of TV and online learning, respectively, in country group k.

The weight w is taken from the average share of online learners relative to students who use the TV mode of instruction during school closures in developing Asian economies (UNESCO, UNICEF, and World Bank 2020a). Data on internet penetration and TV penetration are based on the International Telecommunication Union's World Telecommunication/ICT Indicators Database. Estimates of the effectiveness of TV and online learning are based on the share of countries in each income group that perceived TV/online learning as "very effective" (UNESCO, UNICEF, and World Bank 2020b). Data on perceived effectiveness is available for only nine low-income countries. Given this small sample, the average effectiveness in the LMIC group is applied on the two low-income countries covered in this analysis.

The change in the dropout rate is a function of income shock and dropout-income elasticity in country c. The dropout-income elasticities of children ages 4–11 (preprimary and primary) and 12–17 (secondary) are calculated using individual data from Labor Force Surveys in Cambodia, Fiji, India, Nepal, Pakistan, the Philippines, and Sri Lanka, which contain information on children in these two age groups. The dropout-income elasticity of children in age group j is computed using the following linear probability model:

$$\Pr(o_{ij} = 1) = \alpha_j + \beta_j ln y_{ij} + \varepsilon_j,$$

where o_{ij} is a binary variable that takes the value 1 if child i is out-of-school and 0 if in school, α_j is the intercept, y_{ij} is income per capita in child i's household, and ε_j is the error term. In economies with no Labor Force Survey data on children in these age groups, the average dropout-income elasticity of the seven countries just mentioned is imputed. With this specification, the change in the dropout rate for age group j is computed as

$$\Delta d_{cj} = \beta_j \times \log((100 + g_c)/100),$$

where g_c is the income shock in country c. Data on income shocks are based on *Asian Development Outlook 2020* estimates of the percentage change in gross domestic product (GDP) per capita. The change in country c's dropout rate, Δd_c, is computed as the weighted average of the two age groups' change in dropout rates.

The length of each economy's school closure is taken from the UNESCO's COVID-19 Response data for 44 out of 46 economies in developing Asia and the Oxford COVID-19 Government Response Tracker for Hong Kong, China and

Taipei,China. This is expressed in annual terms by normalizing the number of days by 365. Each economy's data on baseline EYS is taken from the World Bank's 2020 Human Capital Index.

School closures reduce harmonized test scores (quality effect) by as much as the country's average school productivity, p_c, or what students learn in 1 year of going to school. This HTS loss is also mitigated by remote-learning effectiveness. Thus,

$$\Delta HTS = -p_c \times s_c \times (1 - m_c).$$

School productivity is taken from OECD (2010, 2014) estimates of "grade effects" or the Programme for International Student Assessment score-point difference associated with 1 year of schooling. This is available for Azerbaijan, Indonesia, Kazakhstan, the Kyrgyz Republic, Malaysia, the Republic of Korea, Singapore, Thailand, Viet Nam, and Hong Kong, China. In cases where an economy has "grade effects" estimates in both OECD 2010 (for reading) and OECD 2014 (for mathematics), the higher estimate is taken. For the rest of the economies of developing Asia, the calibrations of school productivity by country income group by Azevedo et al. (2021) are applied. Consistent with the standard way of calculating LAYS, school productivity is normalized by 625 points, the threshold for advanced achievement.

A2 Sensitivity analysis

This sensitivity analysis shows what happens to learning and earning losses if partial school closures were not equivalent to half a day of full closure. The form and extent of closures vary over time. Some economies in developing Asia have left the decision to local government units, so no comprehensive accounts exist of how partial closures were implemented in practice. The best that can be done is to make assumptions on the degree of partial closures, and here alternative weights are considered.

If each day of partial closure is equivalent to 0.75 of a full closure, the average learning losses in developing Asia reached one-third of a learning-adjusted school year in the intermediate scenario (Table A2.1). In the optimistic scenario for the effectiveness of remote learning, students in the region lost 25% and in the pessimistic case 42% of a learning-adjusted year of schooling. But if partial closures are closer to full reopening than full closure, such that their weight is 0.25, students in the region lost about one-quarter of a year in learning. In the optimistic scenario, they lost one-fifth of a year and one-third in the pessimistic scenario.

Total losses in potential earnings could reach $1.5 trillion if partial school closures are more similar to full closures, with a weight of 0.75 relative to full closures (Table A2.2). These losses are equivalent to 6.3% of developing Asia's 2020 GDP.

The present value of losses in future earnings can reach up to 9.0% of GDP in the pessimistic scenario for the effectiveness of remote learning. But if partial school closures were equivalent to one-fourth of full closures, developing Asia stands to lose $1.0 trillion over the working life of present-day students, equal to 4.4% of 2020 GDP. Total losses in potential earnings are 3.0% of GDP in the optimistic scenario and 6.3% in the pessimistic scenario.

Table A2.1 Average learning losses in LAYS under alternative weights of partial school closures

	Partial closure weight = 0.75			Partial closure weight = 0.25		
Subregion	Optimistic	Intermediate	Pessimistic	Optimistic	Intermediate	Pessimistic
Central Asia	0.20	0.27	0.36	0.17	0.22	0.29
East Asia	0.29	0.44	0.64	0.21	0.30	0.42
South Asia	0.55	0.62	0.73	0.43	0.48	0.56
Southeast Asia	0.30	0.38	0.50	0.25	0.32	0.41
The Pacific	0.07	0.09	0.12	0.06	0.08	0.10
Developing Asia	**0.25**	**0.33**	**0.42**	**0.20**	**0.26**	**0.33**

LAYS = learning-adjusted years of schooling.

Note: These estimates do not include the following economies because data are not available for at least one parameter: Afghanistan; Bhutan; the Cook Islands; Kiribati; Maldives; the Marshall Islands; the Federated States of Micronesia; Niue; Palau; Papua New Guinea; Solomon Islands; Taipei,China; Tonga; and Tuvalu.

Source: Asian Development Bank estimates.

Table A2.2 Aggregate earning losses in developing Asia, by weight of partial closures

	Loss in lifetime earnings, current $ million			Loss in lifetime earnings, % of 2020 GDP		
Weight of partial closures	Optimistic	Intermediate	Pessimistic	Optimistic	Intermediate	Pessimistic
0.75	980,952	1,468,572	2,102,112	4.2	6.3	9.0
0.50	841,604	1,251,149	1,784,155	3.6	5.4	7.6
0.25	701,867	1,032,919	1,464,485	3.0	4.4	6.3

GDP = gross domestic product.

Note: These estimates do not include the following economies because data are not available for at least one parameter: Afghanistan; Bhutan; the Cook Islands; Kiribati; Maldives; the Marshall Islands; the Federated States of Micronesia; Niue; Palau; Papua New Guinea; Solomon Islands; Taipei,China; Tonga; and Tuvalu.

Source: Asian Development Bank estimates.

A3 Learning and earning losses in developing Asian economies

Table A3.1 Learning losses in developing Asian economies

	Learning losses						
	Average loss in LAYS			% decline in LAYS			Baseline
	Optimistic	Intermediate	Pessimistic	Optimistic	Intermediate	Pessimistic	LAYS 2020
Central Asia	**0.19**	**0.24**	**0.32**	**2.24**	**2.93**	**3.86**	**8.32**
Armenia	0.10	0.15	0.21	1.25	1.87	2.67	7.99
Azerbaijan	0.19	0.29	0.42	2.43	3.51	5.01	8.28
Georgia	0.22	0.34	0.48	2.80	4.08	5.85	8.27
Kazakhstan	0.19	0.28	0.40	2.34	3.07	4.38	9.13
Kyrgyz Republic	0.61	0.69	0.82	7.62	8.02	9.43	8.65
Tajikistan	0.00	0.00	0.00	–0.03	–0.04	–0.04	6.79
Turkmenistan	0.00	0.00	0.00	–0.03	–0.04	–0.04	...
Uzbekistan	0.18	0.20	0.24	2.23	2.24	2.64	9.13
East Asia	**0.23**	**0.39**	**0.59**	**2.18**	**3.67**	**5.64**	**10.50**
Hong Kong, China	0.16	0.43	0.78	1.98	3.60	6.55	11.89
Mongolia	0.47	0.53	0.63	5.85	5.83	6.87	9.15
People's Republic of China	0.17	0.26	0.38	2.17	2.84	4.09	9.27
Republic of Korea	0.11	0.32	0.58	1.43	2.72	5.00	11.68
South Asia	**0.49**	**0.55**	**0.65**	**7.56**	**8.56**	**9.99**	**6.46**
Afghanistan	0.36	0.37	0.40	4.47	7.41	7.91	5.05
Bangladesh	0.58	0.67	0.79	7.31	11.14	13.12	5.99
Bhutan	0.46	0.52	0.62	5.74	8.29	9.77	6.33
India	0.57	0.64	0.76	7.07	9.06	10.63	7.10
Nepal	0.57	0.65	0.77	7.16	9.04	10.65	7.23
Pakistan	0.33	0.37	0.44	4.08	7.33	8.65	5.08
Sri Lanka	0.56	0.64	0.75	6.99	7.54	8.88	8.46
Southeast Asia	**0.27**	**0.35**	**0.45**	**3.26**	**4.20**	**5.45**	**8.34**
Brunei Darussalam	0.05	0.15	0.27	0.64	1.58	2.91	9.22
Cambodia	0.37	0.42	0.50	4.64	6.21	7.34	6.84
Indonesia	0.22	0.33	0.48	2.78	4.28	6.13	7.83
Lao PDR	0.18	0.21	0.25	2.31	3.38	3.98	6.25
Malaysia	0.45	0.67	0.95	5.57	7.51	10.71	8.89
Myanmar	0.67	0.77	0.90	8.41	11.30	13.30	6.79
Philippines	0.53	0.61	0.72	6.66	8.11	9.55	7.49
Singapore	0.04	0.10	0.18	0.54	0.81	1.43	12.81
Thailand	0.15	0.22	0.31	1.84	2.51	3.57	8.68
Timor-Leste	0.15	0.17	0.20	1.89	2.73	3.21	6.29
Viet Nam	0.17	0.20	0.23	2.17	1.86	2.20	10.68
The Pacific	**0.06**	**0.08**	**0.11**	**0.97**	**1.28**	**1.70**	**6.59**
Federated States of Micronesia	0.25	0.28	0.33	3.08	3.91	4.61	7.19
Fiji	0.11	0.16	0.23	1.35	2.35	3.38	6.95
Kiribati	0.04	0.05	0.06	0.54	0.67	0.79	7.38
Marshall Islands	0.01	0.02	0.02	0.14	0.29	0.40	5.66
Nauru	0.00	0.00	0.00	0.02	0.02	0.02	6.51
Palau	0.04	0.09	0.16	0.44	1.03	1.86	8.69
Papua New Guinea	0.08	0.09	0.11	1.00	1.52	1.79	6.00
Samoa	0.04	0.06	0.08	0.49	0.79	1.12	7.25
Solomon Islands	0.06	0.07	0.09	0.81	1.57	1.84	4.68
Tonga	0.02	0.03	0.05	0.30	0.49	0.70	7.14
Tuvalu	0.07	0.10	0.15	0.86	1.74	2.50	6.00
Vanuatu	0.05	0.05	0.06	0.57	0.92	1.07	5.62

... = not available in the World Bank Human Capital Index, Lao PDR = Lao People's Democratic Republic, LAYS = learning-adjusted years of schooling.

Sources: World Bank Human Capital Index for LAYS 2020; Asian Development Bank estimates.

Table A3.2 Earning losses in developing Asian economies

A = Optimistic, B = Intermediate, C = Pessimistic

Economies and subregions	Loss in earnings per student per year, current $			% decline in earnings per student per year			Baseline average earnings per worker per year, current $	Loss in lifetime earnings, current $ million		
	A	B	C	A	B	C		A	B	C
Central Asia	**39**	**56**	**78**	**1.1**	**1.6**	**2.2**	**3,552**	**8,127**	**11,361**	**15,572**
Armenia	6	9	13	0.2	0.3	0.5	2,828	24	36	51
Azerbaijan	78	117	168	1.7	2.6	3.7	4,481	1,421	2,130	3,043
Georgia	87	131	188	1.7	2.6	3.7	5,059	557	841	1,206
Kazakhstan	83	124	177	1.5	2.2	3.2	5,552	3,814	5,713	8,156
Kyrgyz Republic	10	12	14	4.4	5.0	5.9	233	143	163	191
Tajikistan	0	0	0	0.0	0.0	0.0	...	0	0	0
Turkmenistan	0	0	0	0.0	0.0	0.0	...	0	0	0
Uzbekistan	46	52	62	1.4	1.7	2.0	3,157	2,168	2,478	2,926
East Asia	**332**	**771**	**1,344**	**1.7**	**4.0**	**7.0**	**19,182**	**551,989**	**896,251**	**1,340,785**
Hong Kong, China	352	952	1,734	1.5	4.1	7.5	23,189	785	2,126	3,871
Mongolia	218	249	293	4.3	4.9	5.8	5,065	1,585	1,809	2,132
PRC	182	276	397	1.8	2.7	3.9	10,169	503,147	762,687	1,096,668
Republic of Korea	576	1,608	2,953	1.5	4.2	7.7	38,306	46,471	129,628	238,114
South Asia	**68**	**78**	**92**	**3.5**	**4.0**	**4.7**	**1,948**	**171,866**	**195,787**	**230,083**
Bangladesh	70	80	94	3.9	4.5	5.2	1,793	23,420	26,736	31,481
India	59	67	79	3.5	4.0	4.7	1,676	125,529	142,870	167,736
Nepal	91	103	122	4.4	5.1	6.0	2,045	4,339	4,954	5,836
Pakistan	42	48	57	2.2	2.5	3.0	1,898	15,030	17,176	20,256
Sri Lanka	79	90	106	3.4	3.9	4.5	2,331	3,548	4,051	4,773
Southeast Asia	**105**	**167**	**247**	**1.2**	**1.9**	**2.9**	**8,663**	**109,454**	**147,503**	**197,366**
Brunei Darussalam	94	267	495	0.5	1.3	2.5	19,816	87	248	459
Cambodia	36	41	49	1.3	1.5	1.7	2,838	1,570	1,799	2,129
Indonesia	41	62	89	2.5	3.8	5.4	1,629	25,599	38,545	55,168
Lao PDR	48	55	65	1.4	1.6	1.9	3,427	464	530	624
Malaysia	394	590	841	4.3	6.4	9.2	9,180	27,681	41,500	59,151
Myanmar	111	126	149	6.7	7.6	9.0	1,658	10,243	11,688	13,757
Philippines	115	131	155	3.4	3.9	4.5	3,404	26,904	30,696	36,138
Singapore	146	349	617	0.4	0.9	1.5	40,139	733	1,758	3,105
Thailand	44	66	93	0.8	1.1	1.6	5,875	6,604	9,784	13,881
Timor-Leste	93	106	125	2.4	2.7	3.2	3,862	365	416	488
Viet Nam	34	39	46	1.0	1.1	1.3	3,465	9,202	10,538	12,466
The Pacific	**30**	**42**	**58**	**0.5**	**0.6**	**0.9**	**6,509**	**169**	**247**	**349**
Fiji	69	104	150	1.1	1.6	2.3	6,403	133	201	289
Nauru	0	0	0	0.0	0.0	0.0	...	0	0	0
Samoa	23	34	49	0.4	0.6	0.8	6,005	10	14	20
Tonga	19	28	39	0.2	0.3	0.5	8,260	5	8	11
Vanuatu	26	30	35	0.5	0.6	0.6	5,368	22	24	28

... = not available in ILOSTAT, Lao PDR = Lao People's Democratic Republic, PRC = People's Republic of China.

Sources: ILOSTAT for baseline average earnings per worker; Asian Development Bank estimates.