RESEARCH ARTICLE

Risk for Thai Children from the COVID-19 Pandemic: Quantitative Analysis

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Abstract: The impacts of the Covid-19 pandemic on Thai children's educational outcomes are examined based on a two-step analysis. First, the economic impact of the pandemic on household income is quantified by incorporating simulated macroeconomic variables from the CGE model into a household-level data set. Next, these microsimulation results, along with the Thailand Multiple Indicator Cluster Survey data, are examined to identify the negative impact on children's educational outcomes, using a binary logistic model.

The result confirms the negative impact of Covid-19 on household incomes in all income classes. Unfortunately, households with children are hit harder than others in the same income class. To make matters worse, households with children in the lower- and middle-income classes are more likely to be relegated to a lower income quintile.

The change in household income brings about undesirable children's educational outcomes: decreased attendance; increased dropouts; and inadequate literacy and numeracy skills. These outcomes tend to be exacerbated in lower-income households. The risk of children's exposure to psychological and physical aggression at home is also explored. Evidently, the pandemic created a considerable number of child victims of these abusive practices, especially among primary-school-age children.

Keywords: Covid-19, risk on children, educational outcomes, educational inequality, aggression at home

JEL Classification: I24, D10, D58

In 2020, the Covid-19 pandemic forced the Thai government to delay the opening of schools for the 2020 academic year. This delay eventually led to a country-wide shutdown of schools for the first time in recent history. As of this writing, most schools have not yet fully returned to their "old normal" classroom instructions. The new normal includes online classes, alternate day schooling, half days, etc., which have had an unprecedented level of effects on child education.

Low-income children have been the most adversely affected. According to the Equitable Education Fund (EEF), an organization founded by the Thai government with the objective to expand more equitable educational opportunities for children, as of 2017, there were 590,000 poor primary- and secondary-aged students who were in need of financial support. About 670,000 children, ages 3-17 years old, were out of school. In addition, children from very low-income families had only a five percent chance of continuing higher education (EEF, n.d.). The Covid-19 pandemic has worsened the situation. EEF (2021) reported a high number of dropouts among extremely poor children in 2021, and expected even higher numbers in 2022 due to lower household incomes and higher rates of poverty. The dropout rates are particularly high among students who have to change schools or who have advanced to the next school level. For example, the dropout rate from primary to middle school is 22 percent, with an even higher rate of 42 percent from middle to high school (MGRonline, 2021). To exacerbate the situation,

the EEF's proposed 2022 budget was cut by 26 percent. This implies that about 700,000 marginalized children from the poorest 20 percent of households will not have sufficient financial support to continue their education (Matichon Online, 2022; MGRonline, 2021).

Furthermore, during the period of school closures, with in-class learning substituted by on-line studying, students have encountered several problems. Among the major problems are: inadequate learning equipment; lack of internet access; lack of assistance from parents or caregivers; and an overall poor learning environment. Most, if not all, of these problems stem from parents' money and time constraints. The aforementioned problems lead to learning loss for children from low-income households (Apinunmahakul, Sudsawasd and Mongsawad 2023). The ongoing education crisis presents a clear and present danger to the country's educational system; it will increase education disparity, resulting in a widened opportunity gap between the rich and the poor.

We aim to illustrate the impact of the Covid-19 pandemic on learning outcomes of children aged 6-14 years old. We incorporate simulated macroeconomics variables from a Computable General Equilibrium (CGE) model with household-level data from the Thailand Socio-Economic Survey to quantify the impact of the pandemic on household incomes. The results are then used along with the Thailand Multiple Indicator Cluster Survey (MICS) data to examine the negative impact on children's educational outcomes using a binary logistic model. Finally, the risk of children's exposure to domestic abuse, both psychological and physical, is also investigated.

This paper is organized as follows. In the next section, we review the literature on the impact of Covid-19 on children's learning outcomes. Then, the models and simulated results are presented, highlighting the malignant impact of Covid-19 on children, especially those from poor households. And the final section provides the conclusion.

Literature Review

The Covid-19 pandemic has caused one of the biggest upheavals in modern times taking millions of lives, causing dramatic economic downturns, and generating widespread social unrest. One of the unprecedented impacts of Covid-19 is that on children's education. World Bank (2020) classified the

channels through which Covid-19 affects a national education system. One such channel is school closures, which has an immediate impact on education costs as well as on children's health and safety. Another channel is the economic crisis, which reduces both demand for and supply of education. Without effective policy responses, Covid-19 can leave a long-term impact on human capital, inequality, and social turmoil in a country.

School Closures

UNICEF (2021) reported that from March 2020 to February 2021, schools around the world were closed for 95 instruction days on average. In 23 countries, a total of 214 million children from pre-primary to upper-secondary levels missed out on three-quarters of normal class instruction. Sadly, 168 million students in 13 countries missed almost all classes. School closures halt academic learning for most students, and the effect is significantly more severe for children in primary school. This learning stall disrupts academic progress and results in underdeveloped literacy and numeracy skills. Inadequate education obstructs the process of knowledge accumulation due to a loss of foundation skills (World Bank, 2020). Several empirical studies and surveys across countries confirm this fact.

For example, in the US, more than 48 percent of first graders tested below the benchmark for reading skill (Turn Learning Loss into Learning Gains, 2021). And Soland et al. (2020) cited the learning loss of more than five million students from grades three to eight. They found that students lose what they learned in a prior year, especially in mathematics. Moreover, the loss is even more profound for lower grades. Engzell, Frey and Verhagen (2021) showed that for even a short period of school closures (eight weeks) in the Netherlands, there is a learning loss equal to a fifth of the school year, regardless of high access to internet facilities and school funding. UNESCO (2021) reported that in Middle Eastern and North African countries, a large percentage of students score below the minimum proficiency level of the PISA test due to school closures.

Another consequence of school closures is the heightening of learning inequality due to disadvantaged children lacking equipment and connectivity, appropriate learning environments, and assistance at home (World Bank, 2020, p.2). According to the Teacher Task Force (2020), approximately one-half of

students around the world face obstacles with regard to learning at home. Around 50 percent of students do not have access to computers; and about 43 percent have no internet access at home. UNICEF (2020) pointed out how severe the disparity is among students from high- and low-income countries. Compared with 9 in 10 students in high-income countries, less than 1 in 20 students in low-income countries has an internet connection at home. The learning disparity is also obvious even in a developed country, as Andrew et al. (2020) demonstrate in the case of England. They found that differences in availability of resources, time spent, and types of activities are the main factors that generate learning inequality between students from rich and poor families. In the US, Agostinelli et al. (2020) discovered that during school closures, students in poorer areas experience learning loss to a greater degree than do those in richer areas.

Moreover, children's health and safety during school closures pose another concern, as World Bank (2020) points out. For poor students, school meals are a significant source or sometimes their only source of nutrition. Roughly 144 million children in India are in the Mid-day Meal Program. Alvi and Gupta (2020) argued that this program is a main source of nutrition for very disadvantaged students. Lack of school meals during school closures causes these already undernourished children to be further endangered. In Thailand, according to a survey of the EEF (cited in UN, 2020, p. 93), approximately 5.8 percent of primary school students and 3.8 percent of lower secondary school students suffer from malnutrition. These groups of students are vulnerable to hunger and undernourishment during this period.

In addition, violence at home and other threats to children increase during school closures. This negative impact on child's safety is more severe for children living in fragile contexts (World Bank, 2020, p. 13). Physical and psychological abuse and child neglect are often consequences of the economic distress experienced by parents. Chenphuengpawn (2020) pointed out that the lockdown measures in Hubei Province, China, result in a tripling of domestic violence rates; and that 90 percent of the reported incidents are related to the pandemic. In Catalan, Spain, the number of calls to helplines rose 20 percent within days following the lockdown. Similarly, in Cyprus, the number of people using helplines rose 30 percent within a week after the first case of infection. In the

case of Thailand, a Mahidol University survey on domestic violence in nine provinces found a marked increase in domestic violence, from 34.6 percent in 2017 to 42.2 percent in 2020, reflecting a correlation with the outbreak of COVID-19 (Pooprasert, 2021).

As reported by the World Health Organization, there are four main causes of domestic violence: (1) family members spending more time together with the violent persons among them; (2) accumulated stress in the family from various environmental factors; (3) social distancing from relatives, siblings, friends, acquaintances; and (4) victims of violence not having access to help (cited in Pooprasert, 2021).

Economic Crisis

The Covid-19 pandemic inevitably affects the economic conditions in many countries. A suppressed demand for labor in the business sector leads to a cut in working hours and to layoffs. The resultant loss of household income pushes many households into poverty, in turn leading to malignant impacts on nutrition, health, education, and other social issues (United Nations, 2020). The International Labor Organization (ILO, 2021) reported that in 2020, the number of working hours worldwide dropped by 8.8 percent, equivalent to 255 million jobs lost. The unemployment rate in the United States, for example, reached its peak in April 2020 at 14.8 percent (24.5 percent for part-time and 12.8 percent for full-time workers) (CRS, 2021). This reduction in demand for labor affects not only parents' jobs, but also those of students; and Aucejo et al. (2020) found that 40 percent of students in the United States lost their jobs during the outbreak.

World Bank (2020) also reported that the economic crisis reduces demand for education due to less ability to pay for education by households. Some children may be forced to leave school and to work to support their families. UNESCO (2020) reported that more than 24 million students around the world are at risk of not returning to school even after school resumes. Moreover, as the pandemic and its negative economic repercussions linger on, parents are not able to pay for their children's education as before, and some have to cut down on educational expenses and move their children to lower-quality and public schools.

During the economic downturn, the government faced a revenue constraint and had to reduce expenditure and investment in education. Since the pandemic situation has been so severe and has lasted for such

a long period, most countries have had to reprioritize their budgets. The allocation of public health and social protection budgets have to be the priority (Rivera, 2021; Al-Samarrai, 2020). This can result in fewer funds being allocated to educational budgets, or such budgets being increased at much slower rates than during the pre-epidemic period, as has been the case in Ukraine, Nigeria, Canada, and the United States. And reduced budgets for education unavoidably affects the quality of education, especially with the large inflow of new students moving from private schools to public schools, which might be overwhelmed and see their quality compromised as a result (World Bank, 2020).

As for the proportion of funds from Thailand's national budget allotted to education (classified by function and by departments, according to the Ministry of Education), it has a tendency to decline. In the fiscal year 2022, less has been allocated to important educational related funds such as the Education Equity Fund, the educational equity fund of the Office of Basic Education Commission, and the educational budgets for disadvantaged children and children with disabilities (Internet Law Reform Dialogue, 2021). This decreased funding has generated concern about educational disparity and retention within the education system in the context of the COVID-19 outbreak. Also, lower budgets can result in reducing the overall quality of education. Despite being an appropriate measure in the short term, Agostinelli et al. (2020) found that online learning is not an adequate replacement for classroom learning. One reason is that students cannot receive positive "spillover" from their peers or "peer effects", which occurs in normal classroom instruction.

Teaching quality may also deteriorate because of distance education. Some teachers have difficulty accessing computer equipment and internet connection, and may lack motivation. And even though in-class learning may resume, older teachers, who have the most teaching experience. are likely to be the ones at most risk of getting sick and dying from the pandemic. As a result, the supply of quality teachers may decrease. Also, as a consequence of the economic recession, in the long run the number of educational institutions can also decrease because of a decrease in demand for (more expensive) private schooling. Thus, a large number of private schools may go out of business or postpone planned expansions. For example, Alam and Tiwari (2021) reported that the Covid-19 outbreak causes approximately 1,000 private schools to shut

down. Most of them are low-cost private schools which are the main educational providers for low-income families in developing countries.

It is obvious that the Covid-19 pandemic affects education in many aspects through many channels, both in the short term and in the long term. Thus, thorough studies and investigation of all aspects of education systems are in dire need. This challenging research will help alleviate the on-going education crisis around the world.

Methodology

To investigate the varied impact of the Covid-19 pandemic on children's lives from the perspective of Covid-19 as an economic crisis, this study employs two models: a Computable General Equilibrium (CGE) model and a binary logistic model. The CGE model employed in this study is the Global Trade Analysis Project (GTAP) model, augmented to capture the effects of change in tourism demand. The model simulation shows the impact of the Covid-19 pandemic on macroeconomic variables, as well as on input-factor (primary factor) prices, output prices, and total outputs. The results will be linked to the household-level data from the 2019 Thailand Socio-Economic Survey (SES) conducted by the National Statistical Office to show the microsimulation impact on income, particularly in households with children. Finally, using the Thailand Multiple Indicator Cluster Survey (MICS) for 2019, the logistic model linked to microsimulation results can be used to estimate the impact that change in household incomes had on child outcomes. More detailed information of each model will be discussed next.

GTAP Model
As stated, the CGE model used in this study is the GTAP model, which is widely used in the study of global trade and other policy issues. The standard GTAP model is multi-region and multi-sector, with perfect competition and constant returns to scale. It relies on sets of behavioral parameters, such as various consumer demand elasticities as well as Armington elasticities of substitution of commodities that can be differentiated across countries. The latest version of the GTAP database, version 10, is used in this study. This version contains trading relations for 65 sectors and 141 countries/regions.[1] One of the main advantages of the GTAP model over a single-country

CGE model is that it takes into account sectoral trade flows among countries. This model is very appropriate for the study of the economic impacts of a pandemic such as Covid 19.

As the Covid-19 pandemic spreads around the world, it inevitably affects global economies, supply chains, and international trade, as well as travel and tourism services. Thailand's economy was hit especially hard by the pandemic as it relies heavily on tourism. In 2019, the Thai tourism sector alone accounted for 20% of GDP and employed more than 7 million people, accounting for 20% of total employment (Surawattananon et al., 2021). Despite the importance of tourism flows, these data are not yet fully integrated into the standard GTAP model. Thus, the GTAP model used in this study is augmented to capture tourism demand from both inbound tourism and domestic tourism.

The augmented GTAP model is built on the previous work of Sudsawasd et al. (2021), which followed Lee and McKibbin (2004), McKibbin and Sidorenko (2006), and McKibbin and Fernando (2020) with the development of a CGE model that could account for the change in tourism demand. Tourism has been identified as one of the major transmission channels of economic shock that can result from the pandemic (Gutierrez, 2021). The other transmission channels included in the model are: the change in the labor force (due to mortality and morbidity); the change in costs of production; the change in consumption demand; and, the change in a country's risk premium. In the case of Thailand, Sudsawasd et al. (2021) showed that around 73% of Covid-19's impact on the Thai economy (measured by a change in real GDP) comes from the channel of tourism demand shocks, in which 84% of the negative impact on tourism demand resulted from reduced inbound tourism. Their findings highlight the significance that the tourism sector and tourism flows

have on Thailand's economy, particularly in light of the Covid-19 pandemic, which should not be ignored when developing the CGE model, and which is used in this study to analyze the effects of the Covid-19 pandemic.

The simulation results from the GTAP model are then linked to the micro-level data. This study thereby conducts data matching between the GTAP database and the Thailand Socio-Economic Survey (SES) dataset by using the price of primary factors (including unskilled labor, skilled labor, and capital) as a linking variable. As a result, household income is reconciled between these two datasets. For simplicity, this study assumes income elasticity of household expenditure to equal one, and the no change in household expenditure patterns occurred during the period under analysis. Finally, the impact of the simulation scenario on household income, as measured by the number of poor people, can be estimated.

Simulation Scenario

For the scenario used in the GTAP model simulation, this study examines the impact of the Covid-19 pandemic at the end of the second wave in Thailand, around the last week of March 2021. The attack rate and the case-fatality rate for all countries used are actual rates as of 2 April 2021 (approximately 15 months since the Covid-19 pandemic began), which were reported in the WHO Coronavirus (Covid-19) Dashboard.[2]

Since Covid-19 can affect inbound and domestic tourism demands differently, this study decomposes tourism demand into inbound tourism and domestic tourism. Following UNWTO (2020)'s forward-looking (worst case) scenario, this study assumes a 78 percent decline in the number of international tourism arrivals as projected before the Covid-19 outbreak. And domestic tourist numbers in all countries are assumed to decline 75 percent. Table 1 presents a summary of the simulation scenario in this study.

Table 1. *Covid-19 simulation scenario*

Attack rate for all countries	Case-fatality rate for all countries	Inbound tourism in Thailand	Domestic tourism in Thailand	Inbound tourism in other countries	Domestic tourism in other countries
The actual rate as of 2 April 2021	The actual rate as of 2 April 2021	78 % reduction in tourist numbers (as projected before the Covid-19 outbreak)	75 % reduction in tourist numbers (as projected before the Covid-19 outbreak)	78 % reduction in tourist numbers (as projected before the Covid-19 outbreak)	75 % reduction in tourist numbers (as projected before the Covid-19 outbreak)

Logit Model

Since the dependent variable is binary, a logistic regression is used to estimate the impact of household income on child outcomes. It can be expressed as follows:

$$\log\left(\frac{Prob(Y_i=1)}{1-Prob(Y_i=1)}\right) = \log\frac{p_i}{1-p_i} = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_n X_{ni} + \varepsilon_i \quad (1)$$

and

$$Prob\ (Y_i = 1) = p_i = \frac{e^{\beta_0+\beta_1 X_{1i}+\beta_2 X_{2i}+\cdots+\beta_n X_{ni}}}{1+e^{\beta_0+\beta_1 X_{1i}+\beta_2 X_{2i}+\cdots+\beta_n X_{ni}}} \quad (2)$$

where   is the vector of unknown parameters to be estimated, and   is the error term.

For the dependent variable (), it is the set of binary outcomes, comprising 4 categories and 6 main indicators. The first category is about a child's access to education, in which this study uses net attendance (*Net Attendance*) as an indicator. It is equal to one, if a child of any given age is attending an education level compatible with his/her age; otherwise, it is equal to zero. The second category is the internal efficiency of the education system. In this study, it is a school dropout (*Dropout*) indicator where it is equal to one, if a child who attended a given grade in the previous school year is no longer attending school in the current school year.

The third category is child development and skills, measured from foundational reading skills and foundational numeracy skills. For a foundational reading skill (*Reading Skills*) indicator, it is equal to one, when a child: succeeds in reading 90 percent of the words in a story correctly (a sub-indicator "*Word Recognition*"); succeeds in responding correctly to three literal questions (a sub-indicator "*Literal Questions*"); and, succeeds in responding correctly to two inferential questions (a sub-indicator "*Inferential*"), otherwise it is equal to zero. And for a foundational numeracy skill (*Numeracy Skills*) indicator: it is equal to one when a child correctly answers all the number reading questions (a sub-indicator "*Number Reading*"); correctly answers all the number discrimination questions (a sub-indicator "*Number Discrimination*"); correctly answers all the addition questions (a sub-indicator "*Addition*"): and, correctly answers all the number pattern tasks (a sub-indicator "*Pattern Recognition*").

In addition to those first three categories, which present various educational outcomes, this study also adds a fourth category: violent disciplinary practices that could arise from family and financial stresses from the pandemic, including psychological aggression and physical punishment at home (see UNICEF, 2010). For a psychological aggression indicator (*Psychological disciplining*), it is equal to one if a child engages in any of these two disciplinary practices: (1) shouting, yelling, and screaming at a child; and (2) calling a child an offensive name such as "dumb" and "lazy"; otherwise, it is equal to zero. Finally, a physical punishment (*Physical disciplining*) indicator is equal to one when a child is subject to any of these six violent disciplinary practices: (1) being shaken; (2) being spanked or hit on the bottom with a bare hand; (3) being slapped on the hand, arm, or leg; (4) being hit on the bottom with a hard object; (5) being hit on the face, head, or ears; and (6) being beaten with an implement over and over as hard as one can.; otherwise, it is zero. All these outcome indicators are constructed and defined according to UNICEF (2010).

For the set of explanatory variables () in determining a child's outcomes, this study uses a similar set of variables that can influence a child's school (and home education) attendance, as suggested in previous works such as UNICEF (2010). It usually has individual, household, and community characteristics, including a child's gender, a child's school age and its squared term, mother's education, household income (measured by wealth index quintile), rurality (urban vs rural areas), and region of residence. For household income, this study utilizes the data mainly from the Thailand

Multiple Indicator Cluster Survey (MICS) which does not ask respondents this question directly. Instead, the survey provides information on household wealth quintiles (the wealth index quintiles). Therefore, this study uses this wealth index quintile indicator as a measurement of household income.

The MICS dataset used in this study comprises data for children of primary-school age (from 6 to 11 years of age) and lower secondary-school age (from 12 to 14 years of age). It is based on two questionnaires from the MICS: the household questionnaire (in which the child outcome indicators are net attendance and school dropout); and the questionnaire for children aged 5 to 14 (where the child outcome indicators are foundational reading and numeracy skills, psychological aggression, and physical punishment). Each questionnaire contains sufficient information for calculating a child's outcomes and determinant factors used for the logit model estimation. In this study, the model is estimated separately for children in primary and those in lower secondary-school age groups.

To link the results from the microsimulation to the logit model of a child's outcomes, the probability values of moving to lower income quintiles for each household are estimated. This information from the microsimulation, together with the estimated probability values of a child's outcome categorized in different wealth quintiles from regression results, can be used to estimate the impact of the Covid-19 pandemic on child outcomes. This is expressed by the number of children, by multiplying the probability values of achieving a child's outcome with the adjusted number of students in each wealth quintile. It is noted that the number of students for each school-age group is obtained from the *Educational Statistics* in the year 2020. And this study uses the same structure of the children's wealth index quintile as in the Thailand MICS 2019.

Results and Discussions

The impact of Covid-19 on children's household income

The microsimulation results derived from the GTAP model indicate that the estimated impact of the Covid-19 pandemic at the end of the second wave has a negative impact on household income. The average monthly income per capita for all households in Thailand decreased from 9,847 baht to 8,492 baht

(a decline of 13.76 percent). And households in the top three quintiles, the middle- and upper-income classes, saw their income drop the most. In particular, those households in the second and third quintiles experienced a decline of average income per capita of around 14.60 percent. For those households in the lower-income class, their household income per capita also falls by more than 10 percent, but less than it does for those in other income classes.

Figure 1 illustrates monthly income per capita in households with children; the microsimulation results are similar to those obtained from all households. Middle- and upper-income households are the ones that are hurt the most by the Covid-19 pandemic, in terms of the percent decrease of average household income per capita. However, it is worth noting that the estimated fall in income per capita is larger in the case of households with children.
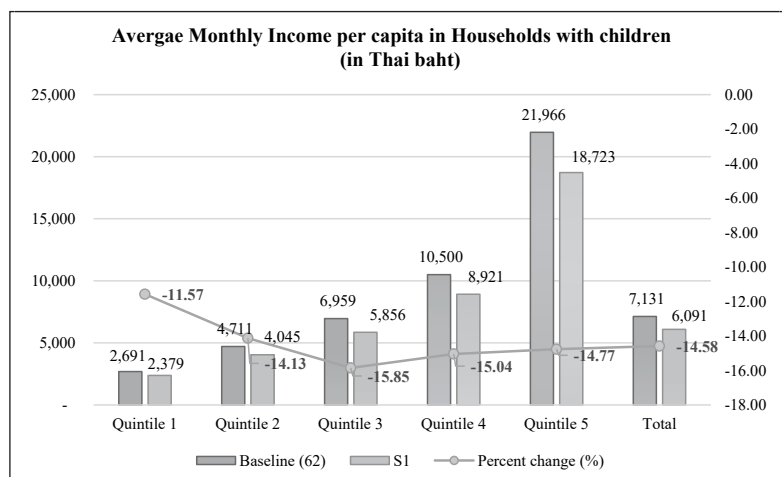
Moreover, the estimated probability values of moving to a lower-income quintile for each household quintile group presented in Figure 2 also point to the same direction. For all households, the average probability value of moving to lower quintiles is 27.4 percent. If only households with children are considered, the average probability values are found to be at 28.2 percent, higher than those households without children. And households in the middle quintiles (2 – 4) have the highest probabilities of moving down to a lower-income quintile.

These results generally suggest that households with children are more vulnerable to suffering and more at risk from financial distress during the pandemic. In particular, lower- and middle-income households with children are more likely to be relegated to a lower income quintile and become poorer or even become newly poor.

The impact of Covid-19 on child outcomes

The results from the logit model of a child's outcomes using data of children of primary-school age and lower secondary-school age are presented in Tables 2 and 3, respectively, which can be summarized as follows:

For primary-school-age children, the school age of children has positive and significant effects on the probability of children's access to education, as well as on their development of skills measured by both foundational reading skills and foundational numeracy skills. However, the effects decrease with

Figure 1. *Estimated impact of the pandemic at the end of the second wave on household income*
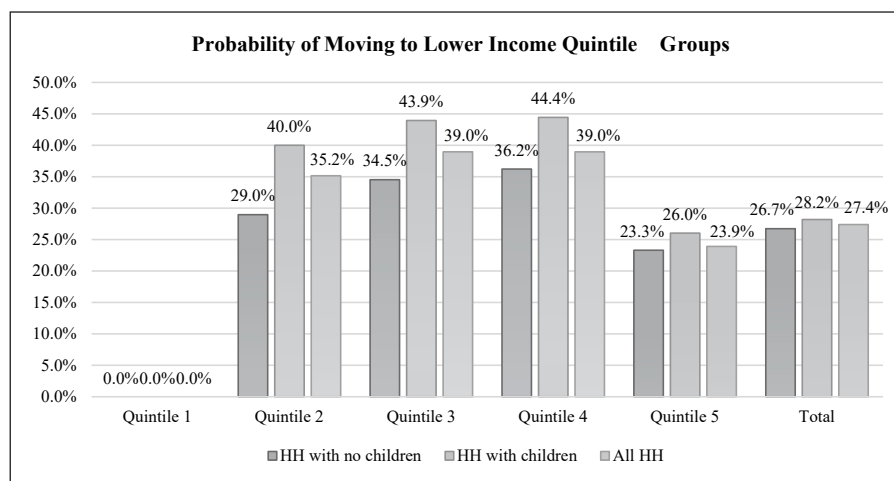
Figure 2. *Estimated probability values of moving to a lower income quintile*

school age, as the negative coefficient of the school age squared variable indicates. Gender also has a significant impact on a child's outcome. Girls are found to have a higher probability than do boys of achieving foundational reading and numeracy skills and a lower probability of being exposed to abuse, including psychological aggression and physical punishment at home. In addition, children who live in rural areas are less likely to experience physical punishment compared with those living in urban areas. Region of household residence also shows a significant effect on the probabilities of both achieving foundational reading skills and exposure to psychological aggression. A mother's level of education proves to be another important factor in the child's development and skills, as mothers with

post-secondary education are likely to stimulate their children's foundational reading and numeracy skills more effectively.

For lower secondary-school age children, the estimation results suggest that school age has positive effects on the probability of achieving higher net attendance in lower secondary education; but the effects decline significantly as school age increases. Girls also have higher probabilities of keeping up school attendance and demonstrating foundational reading skills, as well as lower probabilities of dropping out and being exposed to violent disciplinary practices. Living area (rural or urban), on the other hand, is not found to have any impact on a child's outcomes. In contrast, region of residence is shown to be an important factor. A child living in Bangkok has a

higher probability of developing foundational reading skills as well as a higher probability of being exposed to psychological aggression. Finally, a mother with a higher level of education is found to have positive effects on children as their probability of reaching foundational numeracy skills increases.

Let's turn the discussion to the impact of household income, another variable of interest on children's educational outcomes. The marginal effects of household income measured by the household wealth index quintile are reported in Table 4. Household income is shown to have a significant relationship with net attendance and school dropout, but only for children in the lower secondary school age group. As compared to children in the highest wealth quintile, lower secondary-school age children belonging to households in the lowest wealth quintile are 7.21 percent less likely to have adequate attendance and 5.69 percent more likely to drop out of school.

As for the impact on child development and skills, an increase in children's household wealth index quintiles is associated with a higher probability of attaining foundational reading and numeracy skills for both school-age groups. Although the estimated impacts of a household's income factor on foundational numeracy skills are similar for children in both age groups, the impact on foundational reading skills appears to be stronger in the case of primary-school-age children. As shown, primary-school-age children who are in the first three wealth index quintiles (from the bottom to the middle quintiles) have a lower probability of achieving foundational reading skills, as compared with those children in the highest quintile group. In contrast, a household income (or the wealth index quintile) turns out to be an insignificant factor in determining foundational reading skills for lower secondary-school age children. With one exception, a group of lower secondary-school age children in the lowest wealth index quintile is estimated to have 6.96 percent less probability of demonstrating foundational reading skills.

Children in lower wealth quintiles also have a higher probability of being exposed to violent disciplinary practices. Primary-school age children in the lowest quintile have a 16.0 and 14.1 percent higher probability of parental psychological aggression and physical punishment, respectively, as compared with children from the highest quintile. The estimated results for lower secondary-school-age children are similar in both magnitude and direction, as shown

through children in the lowest quintile who are of lower-secondary-school age and have 16.7 and 13.2 percent higher probability of psychological and physical discipline, respectively.

Finally, estimation results from the logit model (the estimated probability values of achieving a child's outcome in each wealth index quintile group in Figure 2) are then linked with microsimulation results from the GTAP model to quantify the impact of the Covid-19 pandemic on child outcomes as expressed by the number of children. The results are presented in Table 5. The estimated impacts that lead to more than one percent change in the number of children are discussed below.

For primary-school-age children, the results suggest that the Covid-19 pandemic will lead to a serious problem of children being exposed to domestic abuse. The number of cases of child victimization from psychological discipline and physical discipline will significantly increase by about 57,843 children (2.49 percent increase) and 45,978 children (2.19 percent increase), respectively. In addition, other major problem areas to be addressed are child development and learning skills that will be negatively affected by the pandemic. The number of children demonstrating foundational reading skills will decrease by 45,112 children (1.59 percent decrease), as well as the number of children showing foundational numeracy skills, which will also decrease, by 40,820 children (1.34 percent decrease).

The results for lower-secondary school-age children are somewhat different. In contrast to primary-school age children, the biggest problem in the lower-secondary school age children group is school dropout. A large number of students will simply not return to school. This study estimates the number to be around 10,306 children (an 11.11 percent increase in the number of school dropouts). Exposure to violence is also another important problem for lower-secondary-school-age children. Both physical and psychological disciplinary practices are identified as another point of concern, as the number of children affected is more than one percent. Lastly, the Covid-19 pandemic may indeed have a very limited negative impact on lower-secondary school-age children's school attendance and development of basic academic skills, as both the number of student's attendance and the number of children achieving foundational reading and numeracy skills decrease much less than one percent.

Table 2. *Determinants of child outcomes for primary-school-age children.*

Variable	School Attendance	School Dropout	Reading Skills	Numeracy Skills	Psycho Discipline	Physical Discipline
School age	7.546***	-1.101	1.856***	1.683***	0.202	0.011
	(17.62)	(-1.76)	(7.54)	(6.80)	(1.28)	(0.07)
School age²	-0.414***	0.070	-0.079***	-0.069***	-0.0125	-0.007
	(-16.10)	(1.93)	(-5.66)	(-4.88)	(-1.34)	(-0.74)
Sex: Female (vs Male)	0.121	-0.221	0.247***	0.190***	-0.259***	-0.269***
	(1.32)	(-1.18)	(4.34)	(3.29)	(-5.54)	(-5.74)
Area: Rural (vs Urban)	0.193	-0.331	0.028	-0.009	-0.011	-0.190***
	(1.86)	(-1.62)	(0.44)	(-0.13)	(-0.21)	(-3.57)
Wealth index quintile: (vs Fifth)						
– Poorest	-0.198	0.344	-0.730***	-0.634***	0.663***	0.593***
	(-1.01)	(0.80)	(-6.17)	(-5.24)	(6.95)	(6.19)
– Second	-0.0048	0.238	-0.360**	-0.343**	0.340***	0.502***
	(-0.02)	(0.55)	(-3.09)	(-2.87)	(3.65)	(5.35)
– Middle	-0.293	0.518	-0.335**	-0.311**	0.146	0.366***
	(-1.54)	(1.24)	(-2.90)	(-2.61)	(1.59)	(3.96)
– Fourth	-0.173	0.514	-0.130	-0.211	0.168	0.159
	(-0.92)	(1.24)	(-1.13)	(-1.77)	(1.84)	(1.73)
Region: (vs Bangkok)						
– Central	0.331	-0.002	0.289*	-0.165	0.872***	0.221
	(1.42)	(-0.00)	(2.03)	(-1.07)	(7.04)	(1.85)
– North	0.132	-0.150	0.386*	-0.217	0.994***	0.0372
	(0.53)	(-0.33)	(2.51)	(-1.32)	(7.49)	(0.29)
– Northeast	-0.116	-0.394	0.626***	0.034	0.228	-0.346**
	(-0.50)	(-0.91)	(4.33)	(0.22)	(1.82)	(-2.87)
– South	-0.153	-0.466	-0.383**	-0.470**	0.610***	0.058
	(-0.66)	(-1.05)	(-2.63)	(-2.99)	(4.83)	(0.47)
Mother's education: (vs Post-secondary)						
– Upper secondary	-0.105	-0.349	-0.167	-0.308**	0.070	0.048
	(-0.64)	(-0.83)	(-1.62)	(-2.93)	(0.87)	(0.60)
– Lower secondary	-0.273	0.683	-0.391***	-0.382***	0.006	-0.048
	(-1.62)	(1.89)	(-3.70)	(-3.51)	(0.07)	(-0.57)
– Primary	-0.344*	0.540	-0.406***	-0.496***	0.0314	-0.077
	(-2.18)	(1.54)	(-4.18)	(-4.96)	(0.41)	(-1.00)
– None or ECE	-1.066***	1.516***	-0.788***	-1.074***	-0.0573	-0.110
	(-4.46)	(3.55)	(-4.99)	(-6.75)	(-0.42)	(-0.83)
Constant	-28.95***	-0.689	-9.176***	-7.755***	-1.559*	0.165
	(-17.25)	(-0.26)	(-8.64)	(-7.31)	(-2.37)	(0.25)
Observations	10,605	10,605	6,199	6,199	7,651	7,651

Notes: t-statistics are in parentheses. *, **, *** denote the significance at the 5%, 1%, 0.1% levels, respectively.

Table 3. *Determinants of child outcomes for lower secondary-school-age children.*

Variable	School Attendance	School Dropout	Reading Skills	Numeracy Skills	Psycho Discipline	Physical Discipline
School age	32.00***	-0.553	3.485	1.112	-1.759	-4.106
	(9.97)	(-0.12)	(1.23)	(0.35)	(-0.86)	(-1.73)
School age²	-1.196***	0.044	-0.129	-0.033	0.0649	0.149
	(-9.65)	(0.25)	(-1.18)	(-0.27)	(0.82)	(1.63)
Sex: Female (vs Male)	0.371***	-0.943***	0.291**	0.042	-0.152*	-0.211*
	(4.14)	(-5.51)	(2.82)	(0.37)	(-2.03)	(-2.47)
Area: Rural (vs Urban)	0.082	-0.166	-0.040	-0.082	0.0235	-0.108
	(0.80)	(-0.94)	(-0.33)	(-0.62)	(0.27)	(-1.10)
Wealth index quintile: (vs Fifth)						
– Poorest	-0.657***	2.126***	-0.528*	-1.186***	0.715***	0.749***
	(-3.40)	(3.84)	(-2.48)	(-4.18)	(4.62)	(4.16)
– Second	-0.477*	1.686**	-0.300	-1.048***	0.593***	0.599***
	(-2.49)	(3.03)	(-1.42)	(-3.72)	(3.87)	(3.35)
– Middle	-0.220	1.208*	-0.292	-0.960***	0.322*	0.293
	(-1.14)	(2.14)	(-1.40)	(-3.42)	(2.13)	(1.64)
– Fourth	-0.236	1.048	0.027	-0.432	0.475**	0.320
	(-1.20)	(1.81)	(0.12)	(-1.45)	(3.11)	(1.78)
Region: (vs Bangkok)						
– Central	0.009	0.495	0.808***	-0.026	1.301***	-0.022
	(0.04)	(0.91)	(3.61)	(-0.08)	(6.11)	(-0.11)
– North	-0.212	-0.134	1.164***	-0.118	1.190***	-0.278
	(-0.82)	(-0.23)	(4.51)	(-0.36)	(5.25)	(-1.22)
– Northeast	-0.0698	-0.260	1.287***	0.476	0.843***	-0.406
	(-0.29)	(-0.47)	(5.50)	(1.49)	(3.90)	(-1.92)
– South	-0.904***	0.860	0.113	-0.125	0.869***	0.036
	(-3.74)	(1.56)	(0.49)	(-0.39)	(3.92)	(0.16)
Mother's education: (vs Post-secondary)						
– Upper secondary	-0.247	0.311	-0.300	-0.662*	-0.138	-0.012
	(-1.35)	(0.68)	(-1.42)	(-2.41)	(-0.94)	(-0.07)
– Lower secondary	-0.224	0.417	-0.429	-0.670*	-0.055	0.286
	(-1.17)	(0.91)	(-1.92)	(-2.37)	(-0.36)	(1.62)
– Primary	-0.385*	0.669	-0.415*	-0.586*	0.114	0.128
	(-2.24)	(1.59)	(-2.08)	(-2.24)	(0.84)	(0.81)
– None or ECE	-1.358***	1.448**	-0.693*	-0.819*	-0.529*	0.217
	(-5.87)	(3.09)	(-2.46)	(-2.45)	(-2.46)	(0.92)
Constant	-210.2***	-5.465	-21.99	-5.432	10.20	26.70
	(-10.16)	(-0.19)	(-1.20)	(-0.27)	(0.77)	(1.74)
Observations	4,561	4,561	2,918	2,918	3,014	3,014

Notes: t-statistics are in parentheses. *, **, *** denote the significance at the 5%, 1%, 0.1% levels, respectively.

Table 3. *The impact on child outcomes for children aged 6–14 years*
(Marginal effects of household income measured by wealth index quintile)

(a) Primary-school-age children

Child Outcomes	Marginal Effects (vs the Fifth quintile)			
	Wealth index quintile			
	Poorest	**Second**	**Middle**	**Fourth**
School Attendance				
School Dropout				
Foundational Reading Skills	-0.147***	-0.0698**	-0.0648**	
– Word recognition	-0.110***	-0.0515**		
– Literal Questions	-0.117***	-0.0596**		
– Inferential	-0.145***	-0.063**	-0.062**	
Foundational Numeracy Skills	-0.123***	-0.064**	-0.058**	
– Number Reading	-0.073***	-0.047**	-0.042**	-0.048**
– Number Discrimination	-0.043*			-0.034*
– Number Addition	-0.094***	-0.056**	-0.056**	
– Pattern Recognition	-0.050**			
Psycho discipline	0.160***	0.082***		
Physical discipline	0.141***	0.118***	0.086***	

(b) Lower secondary-school-age children

Child Outcomes	Marginal Effects (vs the Fifth quintile)			
	Wealth index quintile			
	Poorest	**Second**	**Middle**	**Fourth**
School Attendance	-0.072***	-0.0499**		
School Dropout	0.057***	0.035***	0.0195**	0.0155*
Foundational Reading Skills	-0.0696**			
– Word recognition	-0.0398**			
– Literal Questions				
– Inferential	-0.0647**			
Foundational Numeracy Skills	-0.105***	-0.087***	-0.077***	
– Number Reading	-0.025*	-0.032**	-0.033**	
– Number Discrimination				
– Number Addition	-0.084***	-0.055***	-0.055***	
– Pattern Recognition	-0.022*		-0.018*	
Psycho discipline	0.167***	0.137***	0.073*	0.109**
Physical discipline	0.132***	0.102***		

*Notes. *, **, *** denote the significance at the 5%, 1%, 0.1% levels, respectively. The results show blank cells whenever a regression coefficient is not statistically significant.*

Table 5. *The impact on child outcomes for children aged 6–14 years*

(Number of children)

	Primary-school age (4,638,057 children*)				Lower secondary-school age (2,394,240 children*)			
	Without Covid (Person)	With the 2nd Wave of Covid (Person)	Change (Person)	Percent change (%)	Without Covid (Person)	With the 2nd Wave of Covid (Person)	Change (Person)	Percent change (%)
School Attendance	4,378,227	4,377,157	-1,069	-0.02	2,020,353	2,007,470	-12,882	-0.64
School Dropout	52,510	52,439	-71	-0.13	92,803	103,109	10,306	11.11
Foundational Reading Skills	2,840,754	2,795,642	-45,112	-1.59	1,980,596	1,970,048	-10,548	-0.53
– Word recognition	3,667,876	3,626,221	-41,655	-1.14	2,304,801	2,296,389	-8,411	-0.36
– Literal Questions	3,444,759	3,401,505	-43,254	-1.26	2,192,040	2,186,302	-5,737	-0.26
– Inferential	3,039,900	2,987,158	-52,742	-1.73	2,048,305	2,035,038	-13,267	-0.65
Foundational Numeracy Skills	3,057,377	3,016,557	-40,820	-1.34	2,095,256	2,078,524	-16,732	-0.80
– Number Reading	3,875,778	3,857,377	-18,401	-0.47	2,304,815	2,301,446	-3,369	-0.15
– Number Discrimination	3,923,157	3,914,050	-9,108	-0.23	2,290,421	2,288,642	-1,779	-0.08
– Number Addition	3,553,757	3,522,557	-31,200	-0.88	2,215,378	2,201,260	-14,118	-0.64
– Pattern Recognition	4,000,978	3,981,960	-19,018	-0.48	2,337,621	2,333,987	-3,634	-0.16
Psycho discipline	2,323,956	2,381,800	57,843	2.49	1,051,402	1,075,309	23,907	2.27
Physical discipline	2,097,722	2,143,699	45,978	2.19	605,285	627,803	22,518	3.72

Sources. The number of students (*) is from the Educational Statistics in the year 2020, the Office of the Permanent Secretary in the Ministry of Education of Thailand.

Conclusion

The objective of this study is to measure the impact of the coronavirus epidemic on children's educational outcomes. The economic crisis caused by the epidemic affects both employment and income levels, which in turn determine children's well-being. The results from this study are consistent with those from prior literature. First of all, economic turmoil increases household poverty, and households with children are more severely affected. Children between the ages of 12 and 14 from low-income households (Quintiles 1 and 2) are at higher risk of not attending secondary school. They have approximately an 80 percent chance of continuing their education. Household income also has an adverse effect on the dropout number of secondary school students. Students from the poorest 20 percent of families (Quintile 1) are about seven times more likely to drop out of school when compared to students from the richest group (Quintile 5). This result helps clarify the report on missing students from the Equitable Education Fund of Thailand.

Regarding the basic literacy and numeracy skills of primary school students, evidence shows a negative impact of household income on children's skills. Nonetheless, this effect is not found among students from the Quintile 5 households. Several factors and resources, such as money, time, and parental assistance, may help facilitate children's learning in high-income families. Unfortunately, this study also finds a higher risk of children being abused physically and psychologically during school closures. Violence is more prevalent for primary-school-age children from poor families. Children from the poorest families (Quintile 1) have about a 50 percent chance of being severely punished, and this chance decreases as household income increases. All of these malignant impacts of the Covid-19 outbreak are unprecedented and considered a serious threat to all children. Without immediate measures and long-term policy, they can cause a long-term impact on education, human capital, the economy, and society as a whole.

Notes

1 For more information on the structure of the standard GTAP model and the overview of the GTAP 10 database, see Hertel (1997) and Aguiar et al. (2019).
2 https://covid19.who.int/

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